California High-Speed Rail Authority

RFP No.: HSR 14-32

Request for Proposals for Design-Build Services for Construction Package 4

Reference Material, Part C.2 Hydrology and Hydraulics Report

Note: Southern limit of CP4 ends just north of Poplar Ave, at approximately station WS1 5880+00, even though this document shows the limit just north of 7th Standard Road. Work south of the contract limit of WS1 5880+00 should not be considered as part of the contract

CALIFORNIA HIGH-SPEED TRAIN

Engineering Report

RECORD SET 15% DESIGN SUBMISSION

Fresno to Bakersfield

Hydrology, Hydraulics, and Drainage Report

December 2013

RFP No. HSR 14-32 – INITIAL RELEASE - 05/27/2015

CALIFORNIA
High-Speed Rail Authority

California High-Speed Train Project Engineering

Record Set 15% Design Submission Hydrology, Hydraulics, and Drainage Report

Prepared by:

URS/HMM/Arup Joint Venture

December 2013

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Abbreviations

AREMA	American Railway Engineering and Maintenance-of-Way Association
Authority	California High-Speed Rail Authority
BFE	base flood elevations
Caltrans	California Department of Transportation
CCR	California Code of Regulations
CDFG	California Department of Fish and Game
C.F.R.	Code of Federal Regulations
cfs	cubic feet per second
CHSTP	California High-Speed Train Project
CVFPB	Central Valley Flood Protection Board
CVFPP	Central Valley Flood Protection Plan
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
DFIRM	Digital Flood Insurance Rate Map
DWR	Department of Water Resources
EIR/EIS	Environmental Impact Report/Statement
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FMFCD	Fresno Metropolitan Flood Control District
FRRP	Flood Risk Reduction Project
HDM	Highway Design Manual
HEC	Hydraulic Engineering Circular
HST	high-speed train
HU	Hydrologic Unit
KRCD	Kings River Conservation District
RWQCB	Regional Water Quality Control Board
SR	State Route
USACE	United States Army Corps of Engineers
U.S.C.	United States Code
WSE	water surface elevation

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Section 1.0
Introduction

1.0 Introduction

1.1 Project Overview

In 1996, the state of California established the California High-Speed Rail Authority (Authority). The Authority is responsible for studying alternatives to construct a rail system that will provide intercity high-speed train (HST) service on over 800 miles of track throughout California. This rail system will connect the major population centers of Sacramento, the San Francisco Bay Area, the Central Valley, Los Angeles, the Inland Empire, Orange County, and San Diego. The Authority is coordinating the project with the Federal Railroad Administration. The California High-Speed Train Project (CHSTP) is envisioned as a state-of-the-art, electrically powered, high-speed, steel-wheel-on-steel-rail technology that will include state-of-the-art safety, signaling, and automated train-control systems.

The statewide CHSTP has been divided into a number of sections for the planning, environmental review, coordination, and implementation of the project. This 15% Design Submission Hydrology, Hydraulics and Drainage report is focused on the section of the CHSTP between Fresno and Bakersfield, specifically between the CHSTP stations in downtown Fresno and downtown Bakersfield. During the initial planning process, the CHSTP alignment alternatives are dynamic and subject to revision.

1.2 Project Description

1.2.1 Fresno to Bakersfield High-Speed Train Section

The proposed Fresno to Bakersfield (FB) Section of the HST is approximately 114 miles long and traverses a variety of land uses, including farmland, large cities, and small cities. The FB Section includes viaducts and segments where the HST will be on embankment or in cut. The route of the FB Section passes by or through the rural communities of Bowles, Laton, Armona, and Allensworth and the cities of Fresno, Hanford, Selma, Corcoran, Wasco, Shafter, McFarland, and Bakersfield.

The FB Section extends from north of Stanislaus Street in Fresno to the northernmost limit of the Bakersfield to Palmdale Section of the HST at Oswell Street in Bakersfield.

1.2.2 Alignments

The FB HST Section, shown in Figure 1.2-1, is a critical link connecting the northern HST sections of Merced to Fresno and the Bay Area to the southern HST sections of Bakersfield to Palmdale and Palmdale to Los Angeles. The FB Section includes HST stations in the cities of Fresno and Bakersfield, with a third potential station in the vicinity of Hanford. The Fresno and Bakersfield stations are this section's project termini.

The FB Section of the HST is divided into 10 subsections, most of which have multiple alternative alignments. Table 1.2-1 and Figure 1.2-1 illustrate the subsections and their corresponding alignments.

Table 1.2-1
Fresno to Bakersfield Alignment Subsections

<table>
<tr><th rowspan="2">Alignment Prefix</th><th rowspan="2">Alignment Subsection Name</th><th colspan="2">Location</th><th rowspan="2">County</th><th rowspan="2">Corresponding EIR/EIS Alternative</th></tr>
<tr><th>Begin</th><th>End</th></tr>
<tr><td>F1</td><td>Fresno</td><td>San Joaquin St</td><td>E Lincoln Ave</td><td>Fresno</td><td>BNSF</td></tr>
<tr><td>M</td><td>Monmouth</td><td>E Lincoln Ave</td><td>E Kamm Ave</td><td>Fresno</td><td>BNSF</td></tr>
<tr><td>H</td><td>Hanford</td><td>E Kamm Ave</td><td>Iona Ave</td><td rowspan="3">Fresno and Kings</td><td>BNSF (Hanford East)</td></tr>
<tr><td>HW</td><td>Hanford West Bypass</td><td>E Kamm Ave</td><td>Idaho Ave</td><td>Hanford West Bypass 1 & 2</td></tr>
<tr><td>HW2</td><td>Hanford West Bypass</td><td>E Kamm Ave</td><td>Iona Ave</td><td>Hanford West Bypass 1 & 2 Modified</td></tr>
<tr><td>K1</td><td rowspan="6">Kaweah</td><td>Idaho Ave</td><td>Nevada Ave</td><td rowspan="6">Kings</td><td>Hanford West Bypass 2 (at-grade) (connects to C1 [Corcoran Elevated] or C2 [Corcoran Bypass])</td></tr>
<tr><td>K2</td><td>Idaho Ave</td><td>Nevada Ave</td><td>Hanford West Bypass 1 (at-grade) (connects to C3 [BNSF through Corcoran])</td></tr>
<tr><td>K3</td><td>Iona Ave</td><td>Nevada Ave</td><td>BNSF (Hanford East) (connects to C3 [BNSF through Corcoran])</td></tr>
<tr><td>K4</td><td>Iona Ave</td><td>Nevada Ave</td><td>BNSF (Hanford East) (connects to C1 [Corcoran Elevated] or C2 [Corcoran Bypass])</td></tr>
<tr><td>K5</td><td>Iona Ave</td><td>Nevada Ave</td><td>Hanford West Bypass 2 Modified (below-grade) (connects to C1 [Corcoran Elevated] or C2 [Corcoran Bypass])</td></tr>
<tr><td>K6</td><td>Iona Ave</td><td>Nevada Ave</td><td>Hanford West Bypass 1 Modified (below-grade) (connects to C3 [BNSF through Corcoran])</td></tr>
<tr><td>C1</td><td>Corcoran</td><td>Nevada Ave</td><td>Ave 128</td><td rowspan="3">Kings and Tulare</td><td>Corcoran Elevated</td></tr>
<tr><td>C2</td><td>Corcoran Bypass</td><td>Nevada Ave</td><td>Ave 128</td><td>Corcoran Bypass</td></tr>
<tr><td>C3</td><td>Corcoran</td><td>Nevada Ave</td><td>Ave 128</td><td>BNSF (through Corcoran)</td></tr>
<tr><td>P</td><td>Pixley</td><td>Ave 128</td><td>Ave 84</td><td>Tulare</td><td>BNSF</td></tr>
<tr><td>A1</td><td>Allensworth Bypass</td><td>Ave 84</td><td>Elmo Hwy</td><td rowspan="2">Tulare and Kern</td><td>Allensworth Bypass</td></tr>
<tr><td>A2</td><td>Through Allensworth</td><td>Ave 84</td><td>Elmo Hwy</td><td>BNSF (through Allensworth)</td></tr>
</table>

Alignment Prefix	Alignment Subsection Name	Location		County	Corresponding EIR/EIS Alternative
		Begin	End		
L1	Poso Creek	Elmo Hwy	Whisler Rd	Kern	Allensworth Bypass (connects to BNSF [through Wasco-Shafter])
L2		Elmo Hwy	Poplar Ave		Allensworth Bypass (connects to Wasco-Shafter Bypass)
L3		Elmo Hwy	Whisler Rd		BNSF (through Allensworth) (connects to BNSF [through Wasco-Shafter])
L4		Elmo Hwy	Poplar Ave		BNSF (through Allensworth) (connects to Wasco-Shafter Bypass)
WS1	Through Wasco-Shafter	Whisler Rd	Hageman Rd	Kern	BNSF (through Wasco-Shafter)
WS2	Wasco-Shafter Bypass	Poplar Ave	Hageman Rd		Wasco-Shafter Bypass
B1	Bakersfield Urban	Hageman Rd	Baker St	Kern	BNSF (Bakersfield North)
B2	Bakersfield Urban	Hageman Rd	Baker St		Bakersfield South
B3	Bakersfield Urban	Hageman Rd	Baker St		Bakersfield Hybrid

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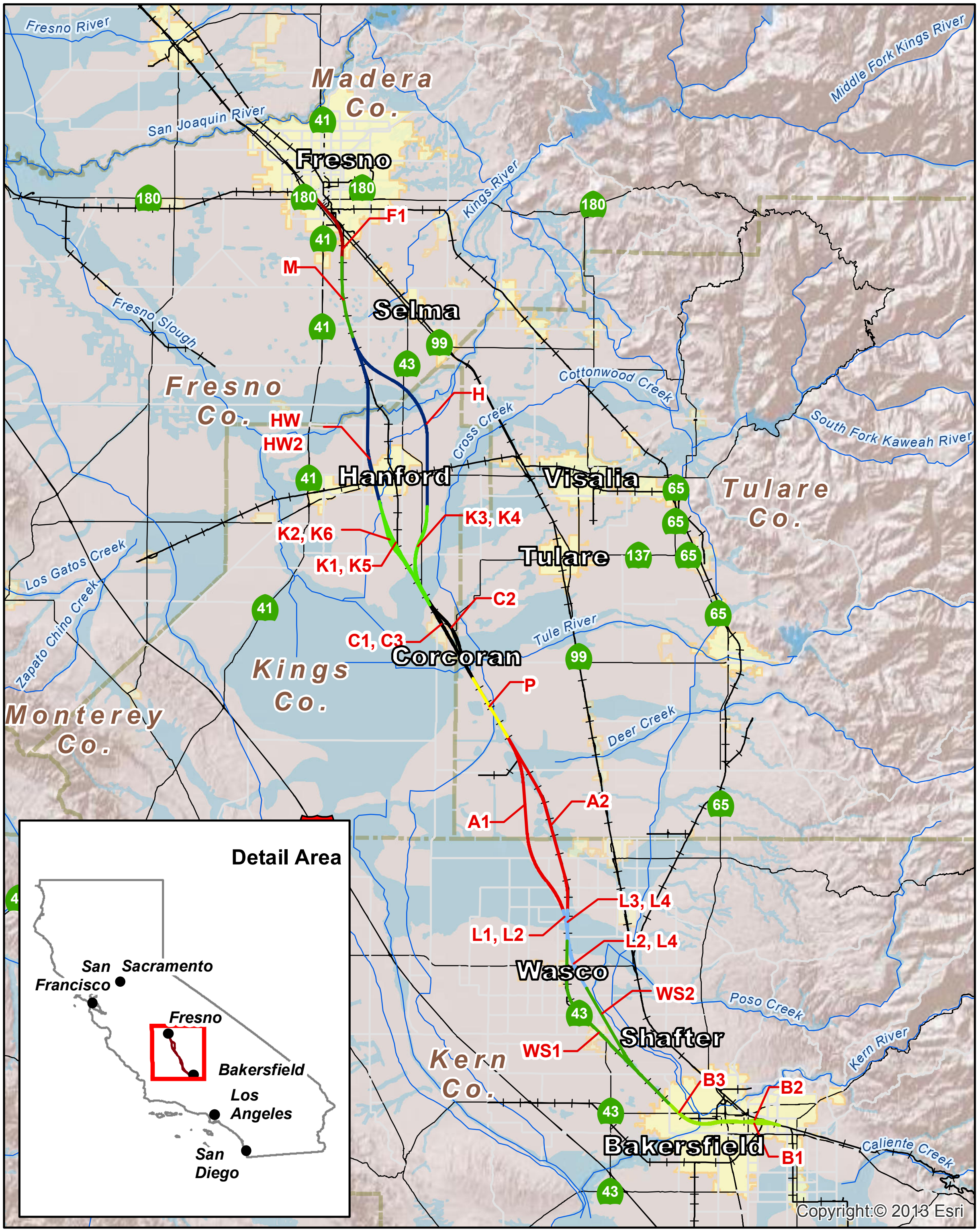

Figure 1.2-1

Alignment Overview

1.3 Purpose

This Hydrology, Hydraulics, and Drainage Report describes hydrologic and hydraulic analysis methods and preliminary drainage design concepts for natural channels, sloughs, and manmade drainage features that will be crossed by the proposed HST alignments between Central Fresno and Oswell Street in Bakersfield. Discussions regarding potential impacts to floodplains are prepared under separate cover titled *Floodplains Impact Report*. Discussions on stormwater quality are under a separate cover titled *Stormwater Quality Management Report*.

1.4 Setting

The area has a typical Mediterranean climate. Summers are long, hot, and dry; winters are cool, moist, and relatively short (United States Army Corps of Engineers [USACE] 1996). Annual rainfall in the area from Fresno to Bakersfield ranges between 5.5 and 10.5 inches (Western Regional Climate Center 2010), with the majority of the precipitation occurring between November and April. Runoff events correspond to rainfall and snowmelt (USACE 1996). Three types of storms produce precipitation in the area: general winter storms, thunderstorms, and tropical cyclones called the "pineapple express." Flooding is most often caused by high intensity rainfall during general winter storms, and severe flooding can result from tropical cyclones.

The Central Valley is fairly level, with slopes commonly less than 1%. Natural vegetation is somewhat sparse; however, most of the land area is dedicated to heavy agricultural production. Due to the generally low rainfall in this portion of the Central Valley, agriculture is heavily dependent on a vast network of irrigation canals that crisscross the valley floor. Both irrigation flows and stormwater are conveyed through the irrigation network, as well as by natural streams.

Land uses near the project include a mixture of agricultural, open space, residential, commercial, industrial, railroad, highway, and flood control uses. Soils in the valley tend to be sands and silty sands.

Future climate change in the Central Valley is a possibility. The California Water Plan notes that climate change has been observed in the average Sierra Nevada snowpack decreasing by approximately 10% during the last century, the sea level rising 7 inches along California's coast, peak natural flows increasing over the last 50 years on many of the state's rivers, and many Southern California cities experiencing their lowest recorded annual precipitation twice within the past decade (California Department of Water Resources [DWR] 2009).

1.4.1 Watersheds

The project is within the Tulare Lake Basin, which has a drainage area of 17,400 square miles (CVRWQCB 2004). The Tulare Lake Basin is drained by the ephemeral Kings, Kaweah, Tule, and Kern Rivers, which flow to the dry beds of Tulare, Buena Vista, and Kern Lakes. Before agricultural development, the Tulare Lake Basin was dominated by four large, shallow, and mainly temporary inland lakes. The Tulare Lakebed, which was the most northerly lake of the four, has been turned into a system of approximately 103 miles of levees and irrigation canals to direct flooding away from farmed tracts of land (USACE 1996). The Kern River once flowed south and west across the southern portion of the valley through a complex system of sloughs, creeks, ponds, and permanent wetlands, feeding Buena Vista and Kern lakes.

Because of the extensive agriculture diversions, Tulare Lake has been primarily dry since the end of the 19th century — except for a few rare, major flood events whereby the lake temporarily impounds runoff from these watersheds, sometimes with sufficient volume to discharge excess surface water northward into the San Joaquin River (DWR 2009).

The Tulare Lake Basin comprises a portion of RWQCB Central Valley Region 5, including all of Kings and Tulare Counties and portions of Fresno and Kern Counties. Of the 10 subwatersheds in Region 5, the

South Valley Floor subwatershed covers most of the section from Fresno to Bakersfield. DWR has defined and numbered surface water hydrologic units (HU) throughout the state to better manage both studies and capital improvements on a watershed and subwatershed basis. The HUs within the Fresno to Bakersfield Section have been defined and numbered by DWR and RWQCB as part of the South Valley Floor subwatershed: 51, 57, and 58 (see Figure 1.4-1).

1.4.1.1 South Valley Floor Subwatershed Hydrologic Unit 51

South Valley Floor Subwatershed HU 51 includes approximately 1,848,000 acres throughout Fresno, Kings, and Tulare Counties. HU 51 is bounded by the San Joaquin River Hydrologic Basin to the north, HU 52 (Kings River HU) and 53 (Kaweah River HU) to the east, HU 58 to the south, and HU 59 (Coast Range HU) to the west. HU 51 includes the City of Fresno.

The San Joaquin and Kings Rivers are the two principal rivers within or bordering the subwatershed. Fresno Slough and James Bypass on the western side of the subwatershed connect the Kings River with the San Joaquin River. The San Joaquin River has continuous flow, while Kings River, Fresno Slough, and James Bypass are ephemeral. Major engineered features include the California Aqueduct.

1.4.1.2 South Valley Floor Subwatershed Hydrologic Unit 57

South Valley Floor Subwatershed HU 57 includes 853,000 acres in Kern County. HU 57 is bounded by HU 58 to the north, HU 56 (Grapevine HU) to the south and east, and RWQCB Region 3 to the west. HU 57 includes the city of Bakersfield. Hydrologic features include Kern River, Lake Webb, and the Pioneer, Buena Vista, Stine, Sunset, and Kern Island Canals. Major engineered features include the California Aqueduct.

1.4.1.3 South Valley Floor Subwatershed Hydrologic Unit 58

South Valley Floor Subwatershed HU 58 includes 2,569,000 acres throughout Fresno, Kings, Tulare, and Kern Counties. HU 58 is bounded by HU 51 and HU 59 to the north, HU 53 and HU 55 (Southern Sierra HU) to the east, HU 57 to the south, and RWQCB Region 3 to the west.

Major rivers and streams in the subwatershed include the Kaweah, Tule, St. Johns, and Kern Rivers, and Cross and Poso Creeks. The west-flowing Tule River, Deer Creek, and the White River are also major drainages in the subwatershed, which discharge into the Tulare lakebed. Deer and Poso Creeks and the Kaweah, St. Johns, Kern, Tule, and White Rivers are ephemeral. Major engineered features include the Friant Kern Canal and the California Aqueduct.

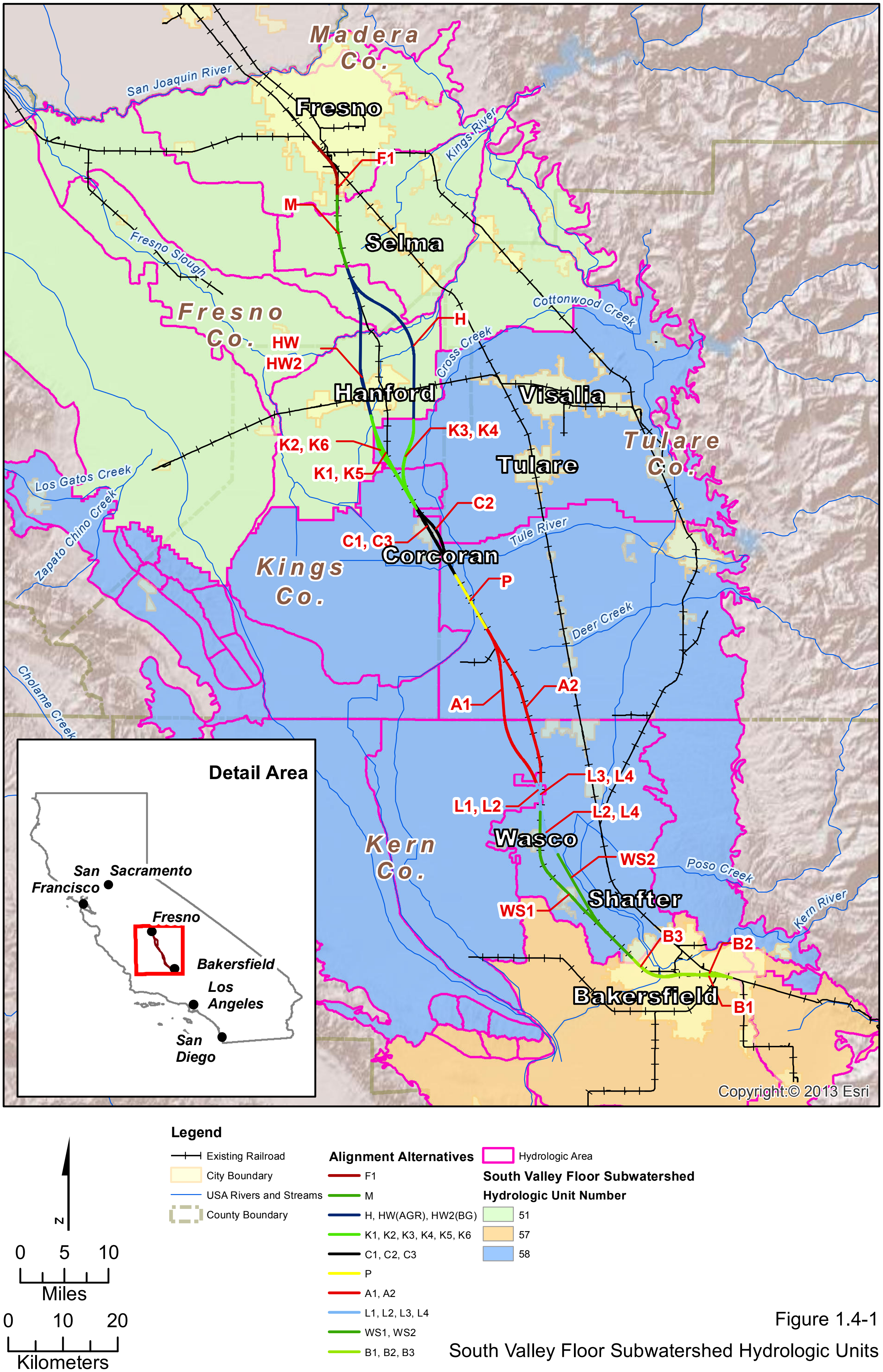

Figure 1.4-1

South Valley Floor Subwatershed Hydrologic Units

1.4.2 Regional Features

1.4.2.1 Local Jurisdictions

The Fresno to Bakersfield Section passes through the following local jurisdictions:

- City of Fresno.
- Fresno County.
- Kings County.
- City of Hanford.
- City of Corcoran.
- Tulare County.
- Kern County.
- City of Wasco.
- City of Shafter.
- City of Bakersfield.

In general, urban areas have existing storm drain facilities that capture and convey surface runoff in the project area. Information on specific local and municipal drainage system design standards for some local jurisdictions is provided below. Additional information will be obtained during later stages of design as local agencies are met with.

County and City of Fresno

The Fresno Metropolitan Flood Control District (FMFCD) provides flood control, urban drainage, and groundwater resource management services within a 400-square-mile watershed located between the Kings River Complex and San Joaquin River. The major FMFCD facilities consist of three reservoirs, five regional flood detention basins, urban basins, and natural and constructed channels (FMFCD 2009). Within Fresno, stormwater runoff is collected in surface drainage structures, pipes, channels, pumps, etc., and transported to basins for storage. Runoff is ultimately either infiltrated or discharged to irrigation channels running through Fresno. The FMFCD owns and operates more than 150 basins in the Fresno area. There are portions of the downtown Fresno area system independent of the FMFCD system and the sole property of the City of Fresno, California Department of Transportation (Caltrans), or private owners, although all discharge to the FMFCD system.

Kings County

The County of Kings, State of California, Improvement Standards (Kings County 2003) should be referenced when detailed drainage design is performed in Kings County.

City of Hanford

The city of Hanford has a stormwater system with over 180 acres of drainage basins. The city also has a new pump station that discharges treated effluent to the Lakeside Ditch Company.

City of Corcoran

In the city of Corcoran, the stormwater system primarily consists of street drainage; however, the system does include lift stations in addition to underground trunk lines for stormwater flows. The system drains to four retention ponds. The system utilizes the Corcoran Irrigation District Canal along Sherman Avenue and Dairy Avenue to carry stormwater flows to the stormwater pond located on Oregon Avenue. The City also utilizes a canal built in 2008 on the west side of the city to convey stormwater flows to a new stormwater pump station on Ottawa Avenue.

Tulare County

Drainage system design for the HST in Tulare County will reference the Improvement Standards of Tulare County (Tulare County 1991).

Kern County

The County of Kern, State of California, Development Standards (Kern County 2010) should be referenced during the detailed design of drainage systems related to the HST in Kern County.

Cities of Wasco and Shafter

The cities of Wasco and Shafter both have stormwater systems. The objectives pertaining to drainage in Shafter, as outlined in the City of Shafter General Plan (City of Shafter 2005a), should be followed during detailed drainage design. Some guidance on drainage design may also be obtained from the City of Shafter Subdivision Engineering and Design Manual (City of Shafter 2005b).

City of Bakersfield

The majority of stormwater runoff in Bakersfield is currently directed to detention basins, with the remainder directed to the Kern River or various canals. Discharges to the Kern River and canals are required to comply with the Tulare Lake Basin Plan.

1.4.2.2 BNSF Railroad

The BNSF railroad consists of 32,000 miles of track spanning the United States and Canada. The BNSF rail line operates year round and transports more than five million shipments annually. The tracks are placed on pervious material (ballast) and elevated approximately 5 feet above grade according to the BNSF Standard Plans (BNSF Railway Company 2007). According to BNSF standards, drainage ditches are located on both sides of the track with a minimum depth of 1 foot and side slopes ranging from 2 horizontal to 1 vertical ratio (2H:1V) to 9H:1V.

Along the BNSF rail line from Fresno to Bakersfield are numerous drainage crossings, including canals that carry irrigation and agricultural drainage, riverine, and cross drainage flows. Larger waterways and canals are typically spanned by bridges or conveyed under the railway by a series of large box culverts. Smaller drainages, minor canals, and cross drainage are conveyed in one or more pipe culverts.

1.4.2.3 Irrigation and Agricultural Drainage Canals

A number of local water supply, flood control, sanitation, and irrigation districts have agricultural water supply, storage, conveyance, and groundwater banking infrastructure that crosses the proposed HST alignments from Fresno to Bakersfield. The districts identified at this time include the following:

Alpaugh Irrigation District
Angiola Water District
Arvin-Edison Water Storage District
Cawelo Water District
City of Corcoran Public Works
City of Fresno Service Area
City of Hanford Public Works
City of Wasco Public Works
Consolidated Irrigation District
Corcoran Irrigation District
Cross Creek Flood Control District
Delano-Earlimart Irrigation District
Kern Delta Water District
Kings County Water District
Kings River Conservation District
Laguna Irrigation District
Lakeside Irrigation Water District
Liberty Water District
Lower Tule River Irrigation District
Melga Canal Company
North Kern Water Storage District
North of the River Sanitary District
Pixley Irrigation District
Rosedale-Rio Bravo Water Storage District

Fresno Irrigation District
Fresno Metropolitan Flood Control District
JG Boswell Water District
Kaweah Delta Water Conservation District
Kern County Water Agency Improvement District No. 4
Semitropic Water Storage District
Shafter-Wasco Irrigation District
Southern San Joaquin Municipal Utility District
Tulare Irrigation District

Within the Fresno-Bakersfield region, canals typically provide irrigation water from riverine diversions during the agricultural planting season and stormwater during the wet season. Such channels often have little to no slope so that water can be moved in either direction. The more significant channels that will intersect the proposed alignments were identified from existing mapping and are listed below:

"A" Ditch
American Colony Canal
Arvin Edison Canal
Bakker Ditch
Blowers Ditch
Calloway Canal
Carrier Canal
Central Canal
Cross Valley Canal
Crosscut Waste
Davis Ditch
East Branch Lakeside Canal
East Branch Peoples Ditch
East Main Last Chance Ditch
East Side Canal
Elkhorn Ditch
Fresno Colony Canal
Friant-Kern Canal
Grant Canal
Hardwick Ditch
Harlan Stevens Ditch
Iowa Dirch
Kern Island Canal
Lakeland Canal
Lakeside Ditch Branches
Liberty Canal
Liberty Ditch
Lone Oak Canal
Melga Canal
Murphy Slough
New Deal Canal
North Central Canal
North Corcoran Ditch
Oleander North Branch Canal
Oleander South Branch Canal
Peoples Ditch
Riverside Ditch
Stine Canal
Sweet Canal
Taylor Canal
Washington Colony Canal
W. Br. Oleander Canal
West Branch Lakeland Canal
West Main Last Chance Ditch
Wristen Ditch/Kirby Ditch

1.4.2.4 Levee Systems

The HST will cross some natural rivers and channels with levee systems.

Three of the levees at the Kings River Complex (Cole Slough/Dutch John Cut/Kings River) are State-Federal Project levees under the jurisdiction of USACE, the Kings River Conservation District, and Central Valley Flood Protection Board (CVFPB). Construction of the HST over these levees will require USACE approval. The CHSTP will aim to avoid impacting the USACE jurisdictional levees at the Kings River Complex.

The levees at Cross Creek within the project area are not USACE jurisdictional levees; however, the levees west of BNSF along Cross Creek and Tule River, outside of project area, are under USACE's jurisdiction. These levees were constructed in 1983 during an emergency situation to protect Corcoran from Tulare Lake flooding. These levees do not meet Federal Emergency Management Agency (FEMA) certification criteria and were not utilized in FEMA hydraulic study.

Church Avenue, Central Canal, County Line Creeks, and Poso Creek have no levees. There is a levee along the south side of the Kern River, but it is not under USACE jurisdiction.

1.5 Regulatory Framework

This section outlines the federal, state, and regional agencies and guidelines that may apply to hydrology, hydraulics, and drainage design within the project area.

1.5.1 Federal Guidance

1.5.1.1 National Flood Insurance Act

Title 42 United States Code (U.S.C.) Section 4001 et seq.

The National Flood Insurance Act requires the purchase of insurance for buildings in special flood-hazard areas. The act is applicable to any federally assisted acquisition or construction project in an area identified as having special flood hazards. Projects should avoid construction of buildings in flood-hazard areas identified by the Federal Emergency Management Agency (FEMA).

FEMA identifies flood-prone areas, regulates development in floodplains, provides inundation mapping on flood insurance rate maps (FIRMs) as part of the National Flood Insurance Program for each community, and provides federally backed flood insurance to homeowners, renters, and business owners. Typically, each county has a flood insurance study (FIS) completed and FEMA works with participating communities to develop FIRMs. The FIRMs divide communities into special flood hazard zones and other areas. Special flood hazard zones are areas inundated by a base, 100-year recurrence interval flood (i.e., 1% chance of annual flooding and 26% chance of flooding over a 30-year period). Special flood hazard zones are further classified by the hydraulic analysis approaches and the level of detail used in delineating the base flood boundaries and determining elevations. Special flood hazard zone classifications are defined in Table 1.5-1.

If a project will substantially alter the extent or depth of the base flood, the project owner must submit supporting documentation and modeling of changed condition. If FEMA approves the development proposal, it issues a Conditional Letter of Map Revision (CLOMR). After construction is complete, as-built construction plans and modeling are submitted to FEMA, and it issues a Letter of Map Revision (LOMR), which officially updates the FIRM.

Within the Fresno to Bakersfield Section, FEMA has conducted detailed flooding studies for Cross Creek, Kern River, and one area within the City of Fresno (Church Street, designated as “Zone AH”).

Other delineated floodplain areas for this section include the Kings River Complex, Tule River, Deer Creek, two unnamed watercourses at the Tulare-Kern County border (referred to in this report as County Line Creeks), and Poso Creek. These flood-prone areas are generally designated “Zone A” by FEMA, indicating a floodplain for which FEMA has determined approximate inundation areas but without detailed flow or water surface elevation (WSE) information.

Table 1.5-1
Special Flood Hazard Zones

Zone	Description
A	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations (BFEs) are shown within these zones.
AE	Areas with 1% annual chance of flooding. The base floodplain where FEMA BFEs are provided. AE zones are now used on new format FIRMs instead of A1–A30 zones.
A1 through A30	These are known as numbered A zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a BFE (old format).
AH	Areas with a 1% annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. BFEs derived from detailed analyses are shown at selected intervals within these zones.

Zone	Description
AO	River or stream flood hazard areas and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.
AR	Areas with a temporarily increased flood risk due to the building or restoration of a flood control system (such as a levee or a dam). Mandatory flood insurance purchase requirements apply, but rates do not exceed the rates for unnumbered A zones if the structure is built or restored in compliance with zone AR floodplain management regulations.
A99	Areas with a 1% annual chance of flooding that will be protected by a federal flood control system under construction, where construction has reached specified legal requirements. No depths or BFEs are shown within these zones.
A1 through A30[1]	These are known as numbered A zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a BFE.
[1]Floodplain Zone Designation in old FEMA format	

1.5.1.2 Rivers and Harbors Act

<u>Protection of Improvements to Navigable Waters</u>
<u>Title 33 U.S.C. Section 403 et seq.</u>

Section 403 of the Rivers and Harbors Act (commonly known as Section 10), administered by the USACE, requires permits for all structures such as pilings, docks, or bridges that are constructed in navigable waters of the United States. Excavation or fill activities such as dredging and placement of fill or riprap in the waterways also require permits. Navigable waters include waters that are subject to the ebb and flow of the tide and rivers used as a means of interstate transport or foreign commerce. USACE grants or denies permits based on the impacts on navigation. Under this definition, the Fresno to Bakersfield Section of HST will not impact navigable waters of the United States. Section 404 of the Clean Water Act (CWA) also covers most of these activities.

<u>Use of Harbor or River Improvements</u>
<u>Title 33 U.S.C. Section 408</u>

Modification of a federal flood control project requires permission by USACE through a Title 33 U.S.C. Section 408 permit. Section 408 specifies the technical and risk analyses that must be submitted to USACE by any nonfederal sponsor of a project that may adversely affect the capacity or structural integrity of a federal flood control facility. The types of information required include detailed structural information, hydraulic data (e.g., water surface profiles), and geotechnical evaluations (e.g., levee seepage and stability). A memorandum, Clarification Guidance on the Policy and Procedural Guidance for the Approval of Modifications and Alterations of Corps of Engineers Projects (USACE 2008), provides detailed information.

A Congressional Briefing Paper (California Water Commission 2011), *Proposed Framework for Guidance Clarifying the U.S. Army Corps of Engineers Section 408 Review Process for Local Funded and Constructed Improvements to Federal Flood Control Projects*, uses the terms "Major 408" and "Minor 408" permits:

- Minor 408s are activities that (i) were previously approved in accordance with Section 208.10 or (ii) go further than simple operations and maintenance but restore "the authorized level of protection or improve the structural integrity of the protection system that do not change the authorized structural geometry or hydraulic capacity that were previously approved in accordance with Section 208.10."

- Major 408s include all degradations, raisings, realignments, and other alteration/modifications not approvable as a Minor 408.

CHSTP improvements will be designed to avoid the need for a Major Section 408 permit.

In January 2013, USACE released a revised general guidance, Minor Section 408 Modification Guidance (USACE 2013). This guidance provides Minor Section 408 submittal requirements for engineering, operation, and maintenance aspects of construction within the critical area of a Flood Risk Reduction Project (FRRP) constructed by USACE and those FRRP in the USACE Public Law 84-99 Rehabilitation and Inspection Program. Where construction is concerned, the critical area for a levee is generally defined as 300 feet riverward to 500 feet landward of the levee's centerline. The review schedule for a Minor Section 408 is six to eight weeks. Local sponsors are the owners of the FRRP and are responsible for controlling all construction activity that occurs within the critical area. No reviews will proceed without permission of the local sponsor.

Local Flood Protection Works
Title 33 Code of Federal Regulations (C.F.R.) Section 208.10

Section 208.10 defines the responsibilities of the USACE for maintenance of flood channels, levees, and other flood protection features constructed by the federal government. USACE approval may be granted under Section 208.10 for alternations or improvements that have little or no impact on the authorized level of protection (capacity) and structural integrity of a federal flood protection project.

The CVFPB, which is part of the California DWR (formerly the California Reclamation Board), administers Section 208.10 in the Central Valley. CVFPB administers permits for encroachments on state and state/federal flood control projects. USACE provides a concurrent review of the technical aspects of encroachment permit applications and provides to CVFPB a list of technical requirements to satisfy USACE responsibilities under Section 208.10.

Since 2006, USACE has considered some modifications and alterations to USACE projects directly under Section 408. From June 18, 2010, Section 408 became the sole authority utilized for approvals to modify USACE projects, and the USACE Districts are authorized to approve pursuant to Section 408 those minor, low-impact modifications to flood protection works operated and maintained by non-federal sponsors that previously were being considered under 33 C.F.R. 208.10(a)(5).

1.5.1.3 Clean Water Act (Title 33 U.S.C. Section 1251 et seq.)

Permit for Fill Material in Waters and Wetlands
Title 33 U.S.C. Section 404

Section 404 of the CWA regulates the discharge of dredged and fill materials into waters of the United States, which include oceans, bays, rivers, streams, lakes, ponds, and wetlands. Emphasis is placed on protection of water quality and conservation of marine and aquatic habitat. Under Section 404 of the CWA, the term "navigable waters" includes not only those waters identified as navigable waters of the United States by Section 10 (Rivers and Harbors Act), but also waters with "a significant nexus to navigable waters."

Projects are encouraged to avoid impacts on water bodies or to minimize impacts where a water body cannot be avoided. Projects mitigate for lost habitat, typically by providing replacement habitat at a different location. A 404 permit application must be submitted to USACE. Nationwide 404 permits exist for a large number of activities that have been determined to cause generally minor impacts. A single application typically covers the requirements of both Section 10 and Section 404 (CWA).

Clean Water Quality Certification
Title 33 U.S.C. Section 401

Under Section 401 of CWA, applicants for a federal license or permit to conduct activities that may result in the discharge of a pollutant into waters of the United States must obtain certification from the state in which the discharge would originate, or, if appropriate, from the interstate water pollution control agency with jurisdiction over affected waters at the point where the discharge would originate. Therefore, all projects that have a federal component and may affect the quality of state waters (including projects that require federal agency approval, such as issuance of a Section 404 permit) must also comply with CWA Section 401. Section 401 certification or waiver is under the jurisdiction of the applicable RWQCB.

National Pollutant Discharge Elimination System
Title 33 U.S.C. Section 402

The CWA requires a National Pollutant Discharge Elimination System (NPDES) permit to be obtained by anyone wanting to discharge pollutants. Section 402 allows the US Environmental Protection Agency (EPA) to authorize the NPDES Permit Program to state governments, enabling states to perform many of the permitting, administrative, and enforcement aspects of the NPDES Program, while still allowing the EPA to retain oversight responsibilities.

In California, the water quality regulations under the CWA have been delegated by the EPA to the State Water Resources Control Board (SWRCB) of California and the various Regional Water Control Boards.

Section 303(d) List of Water Quality Limited Segments

The CWA requires states to identify and make a list of surface water bodies that are polluted. These water bodies do not meet water quality standards even after discharges of waste from point sources have been treated by the minimum required levels of pollution control technology. States must also prioritize the water bodies on the list and develop total maximum daily loads (TMDLs) to improve the water quality. The project-specific 303(d)-listed water bodies are discussed in Section 1.5.3.

1.5.1.4 Executive Order 11988

Executive Order 11988 directs all federal agencies to (1) avoid to the extent practicable and feasible all short-term and long-term adverse impacts associated with floodplain modification and (2) avoid direct and indirect support of development within 100-year floodplains when there is a reasonable alternative. Additional specific information must support projects that encroach on 100-year floodplains.

1.5.1.5 Floodplain Management (U.S. Department of Transportation Order 5650.2)

The U.S. Department of Transportation Order 5650.2, Floodplain Management and Protection, prescribes "policies and procedures for ensuring that proper consideration is given to the avoidance and mitigation of adverse floodplain impacts in agency actions, planning programs and budget requests." The order applies to all floodplains as shown on FEMA FIRMs with the exception of Zone C (areas of minimal flooding). Environmental review documents should indicate potential risks and impacts from proposed transportation facilities.

1.5.1.6 Federal Highway Administration

The Federal Highway Administration (FHWA) requires a floodplain report (location hydraulic study) when a proposed transportation project may encroach on a FEMA-established (100-year) flood hazard area. A similar approach to risk assessment and reporting is proposed for the HST. The minimum required content of the floodplain report must be as prescribed in Title 23 C.F.R. Section 650, as follows:

- The degree of encroachment associated with each alternative, including evaluation and discussion of the practicability of alternatives to any encroachments.
- The risks associated with implementation of the action, including potential for interruption or termination of communities, only evacuation routes, or facilities needed for emergency vehicle and the significant potential for flood-related property loss or hazard to human life.
- The impacts on natural and beneficial floodplain values.
- The support of probable incompatible floodplain development.
- The measures to minimize floodplain impacts associated with the action.
- The measures to restore and preserve the natural and beneficial floodplain values impacted by the action.
- Evaluation and discussion of the practicability of alternatives to any significant encroachments or any support of incompatible floodplain development.

The floodplain report must also discuss the mitigation measures to minimize floodplain impacts and to restore and preserve the natural and beneficial floodplain values that are impacted. This analysis will be completed during later stages of design.

Additionally, FHWA has developed numerous design manuals. Many FHWA design manuals are referenced in the Caltrans Highway Design Manual (HDM) (Caltrans 2011), and many FHWA standards have been adopted by Caltrans. Unless otherwise noted, the CHSTP has adopted Caltrans standards for hydrologic analysis and hydraulics design. Design manuals referenced for this report include the *Design of Roadside Channels with Flexible Linings Hydraulic Engineering Circular (HEC) 15* (FHWA 1988), *Urban Drainage Design Manual HEC 22* (FHWA 2001), and *Design of Bridge Deck Drainage HEC 21* (FHWA 1993).

1.5.2 State Regulations and Guidelines

1.5.2.1 Porter-Cologne Water Quality Act

California Water Code 13000 et seq.

Water quality law in California is governed by the Porter-Cologne Water Quality Act. Primarily the act assigns responsibility for water rights and water quality protection to the SWRCB and directs nine RWQCBs to develop and enforce water quality standards including responsibility for issuance of NPDES permits.

1.5.2.2 State Water Resources Control Board

The SWRCB has adopted water quality standards for the state's waters and issues permits regulating the discharge of wastes into these waters. Permits can be issued by the SWRCB or by the RWQCBs under the jurisdiction of the state board. Details of some of the discharge permits administered by the SWRCB are provided below.

Construction General Permit

On July 1, 2010, the revised General Construction Stormwater Permit took effect, issued by the SWRCB. The requirements for this permit apply to any project that disturbs 1 acre or more of land. For a project to qualify under the general permit, a Notice of Intent (NOI) must be filed with the SWRCB and a Stormwater Pollution Prevention Plan (SWPPP) must be prepared that details the erosion and sediment control measures and other pollution prevention measures that will be implemented at the project site.

The SWPPP must also contain a runoff monitoring plan and measures for inspecting, maintaining, and upgrading, as necessary, the erosion control measures.

The General Construction Stormwater Permit deals with stormwater runoff leaving the project site and may also cover dewatering activities, although the individual RWQCB may have special dewatering requirements. Additional specific requirements are applied depending upon the location of a project and its perceived risk level (see section 2.3 for a discussion on project-specific risk assessment).

Dewatering and Other Low-Threat Discharges to Surface Waters

This General Order covers certain categories of dewatering and other low-threat discharges to waters of the United States, which are either four months or less in duration or have an average dry weather flow that does not exceed 0.25 million gallons per day (from Permit Number R5-2008-0081). The General Permit specifies both effluent limitations and receiving water limitations. Additional details about the permit are available at the SWRCB website: http://www.swrcb.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2008-0081.pdf.

Municipal Separate Storm Sewer Systems

A municipal separate storm sewer system (MS4) is a conveyance or system of conveyances that meets the following:

- Owned by a state, city, town, village, or other public entity that discharges to waters of the United States.
- Designed or used to collect or convey stormwater (including storm drains, pipes, ditches, etc.).
- Not a combined sewer.
- Not part of a publicly owned treatment works (sewage treatment plant).

Phase I, issued in 1990, required medium and large cities or certain counties with populations of 100,000 or more to obtain NPDES permit coverage for their stormwater discharges. Phase II, issued in 1999, required regulated small MS4s in urbanized areas, as well as small MS4s outside the urbanized areas that are designated by the permitting authority, to obtain NPDES permit coverage for their stormwater discharges. Generally, Phase I MS4s are covered by individual permits and Phase II MS4s are covered by a General Permit. Each regulated MS4 is required to develop and implement a stormwater management program to reduce contamination of stormwater runoff and prohibit illicit discharges.

Both Fresno and Bakersfield have Phase 1 MS4 NPDES permits in place, and therefore, consultation will be required in these municipalities.

1.5.2.3 California Department of Fish and Game

Lake or Streambed Alteration Agreement
California Code of Regulations Sections 1601–1603

The California Department of Fish and Game (CDFG) is responsible for, among other things, preserving and protecting aquatic and marine habitats. Under Sections 1601–1603 of the California Code of Regulations (CCR), agencies are required to notify CDFG prior to implementing a project that would substantially divert, obstruct, or change the natural flow of any river, stream, or lake. The project must submit a Notification of Lake or Streambed Alteration and notify CDFG about any action that would substantially alter the channel or streambed or deposit material within the channel. If CDFG determines that the project may adversely affect an existing fish and wildlife resource, it will issue a Lake or

Streambed Alteration Agreement that lists measures that must be completed to adequately protect the resource.

1.5.2.4 California Department of Transportation

Caltrans is not a direct reviewing agency for the CHSTP; however, it has regulatory authority over those portions of the project that involve modifications to state highways. The High-Speed Rail Authority (Authority) has generally agreed to comply with Caltrans's requirements and templates, when practical. Caltrans HDM (Caltrans 2011) contains detailed information for the design of highway and road stormwater systems. For those portions of the HST Project that involve altering or relocating state highways, the drainage design will need to follow Caltrans HDM.

Location Hydraulic Studies

Chapter 804 of the HDM (Caltrans 2009) addresses the topic of floodplains; Section 804.7.2.e states that the results of location hydraulic studies must be summarized in the environmental document prepared for the project. A location hydraulic study is the preliminary investigation of the degree of floodplain encroachment by a project (Caltrans 2009). The study must address the following:

- Flood risks associated with the project.
- Impacts on natural and beneficial floodplain values.
- Identification of probable incompatible floodplain development.
- Measures to minimize floodplain impacts.
- Measures to restore and preserve the natural and beneficial values affected by the project.
- Evaluation of the practicality of alternatives to significant floodplain encroachment.

A significant floodplain encroachment is determined by one or more of the following:

- A significant potential for interruption or termination of a transportation facility that is an emergency vehicle route or a community's only evacuation route.
- A significant risk to life or property.
- A significant adverse impact on the natural and beneficial floodplain values.

Section 804.7 of the HDM states that the location hydraulic studies can be documented in a floodplain evaluation report attached to the project's environmental documentation. The timing of location hydraulic studies may depend in part on whether a state highway is being modified under Caltrans jurisdiction. Caltrans is not a direct reviewing agency for this project; however, the Authority has generally agreed to comply with Caltrans requirements and templates when practical.

Location hydraulic studies must be performed for each of the major floodplains identified in Floodplain Impact Report. The level of detail for these studies is comparable to the analysis required for development permits and should be summarized in a floodplain evaluation report appended to the final.

Environmental Impact Report/Statement

The following should be determined and developed for all relevant water bodies:

- WSE based on the 100-year design flow (or 200-year design flow).

- Map illustrating the FEMA 100-year flood limits (or DWR 200-year floodplain limits) and portions of the project and existing buildings situated within the floodplain.

- Completion of Forms 804.7A (Technical Information for Location Hydraulic Study) and 804.7B (Floodplain Evaluation Report Summary) for projects identified to have minor floodplain impacts (Section 804 of the HDM [Caltrans 2009]).

1.5.3 Regional Regulations

1.5.3.1 Central Valley Regional Water Quality Control Board

For the Fresno to Bakersfield Section, the RWQCB for the Central Valley Region, also known as Region 5, is the primary regulatory agency that will oversee conformance of the project's stormwater quality management system with the Clean Water Act. The California Water Code established the RWQCBs as the primary state agencies for protecting the quality of waters. The RWQCB developed a Tulare Lake Basin Plan, which outlines beneficial uses of water bodies as well as specific water quality objectives for surface and ground waters. The water quality objectives include concentration limits for a large range of pollutants. Regulations for discharges within this area are included in the Water Quality Control Plan for the Sacramento and San Joaquin River Basins (California RWQCB Central Valley Region 2009).

Impaired Water Bodies and Total Maximum Daily Loads

The Fresno to Bakersfield Section drains to several water bodies listed on the 2006 State 303(d) List of Impaired Water Bodies for exotic species, selenium, electrical conductivity, molybdenum, and toxaphene. Table 1.5-2 lists details for each impaired water body within the project area. The listings carry the implication that the receiving waters have exceeded the maximum load of pollutants they can receive while still meeting water quality standards. These maximum amounts are termed TMDLs. The Federal Clean Water Act requires that programs to reduce pollutant loading be implemented for all water bodies listed on the State 303(d) list. These programs are also termed TMDLs.

Table 1.5-2
Clean Water Act Section 303(d): Listed Water Bodies and Priority Pollutants in the Project Vicinity

Name	Pollutant	Source	Status
San Joaquin River (Friant Dam to Mendota Pool) Exotic Species	Exotic species	Source unknown	TMDL required
Mendota Pool	Selenium	Agricultural return flows, agriculture, groundwater withdrawal, other	TMDL required
Kings River, Lower (Island Weir to Stinson and Empire Weirs)	Electrical conductivity	Agriculture	TMDL required
Kings River, Lower (Island Weir to Stinson and Empire Weirs)	Molybdenum	Agriculture	TMDL required
Kings River, Lower (Island Weir to Stinson and Empire Weirs)	Toxaphene	Agriculture	TMDL required
Kings River, Lower (Pine Flat Reservoir to Island Weir)	Chlorpyrifos Unknown Toxicity	Agriculture Source Unknown	TMDL required
Cross Creek (Kings and Tulare Counties)	Unknown Toxicity	Source Unknown	TMDL required
Deer Creek (Tulare County)	pH (high), Unknown Toxicity	Source Unknown	TMDL required

The proposed project is not expected to contribute to exotic species, selenium, molybdenum, and toxaphene. However, heavy metals generated by the rail can potentially affect electrical conductivity.

Tulare Lake Basin Plan

Any project stormwater management plan will need to meet the requirements of the Tulare Lake Basin Plan (California RWQCB Central Valley Region 2009), which provides information on the beneficial uses and TMDLs of the receiving water bodies. Table 1.5-3 lists specific beneficial uses for each water body. Groundwater beneficial uses are organized by detailed analysis units based on the water bodies. Surface water beneficial uses are organized by segments of the relevant water bodies.

1.5.3.2 Central Valley Flood Protection Board

California Code of Regulations Title 23, Division 1

In cooperation with USACE, the CVFPB provides policy direction and coordination for the flood control efforts of state and local agencies along the Sacramento and San Joaquin Rivers and their tributaries. CVFPB cooperates with federal, state, and local government agencies in establishing, planning, constructing, operating, and maintaining flood control works. Additionally, under Section 8609 of the California Water Code, CVFPB has the authority to designate floodways, enforce standards for the construction, maintenance, and protection of adopted flood control plans, and regulate encroachments in a floodway. By issuing permits for encroachments, CVFPB also exercises regulatory authority to maintain the integrity of the existing flood control system and designated floodways.

CVFPB has mapped designated floodways along more than 60 streams and rivers in the Central Valley. CVFPB-designated floodways are different from FEMA floodways. Designated floodways refer to the channel of the stream and that portion of the adjoining floodplain reasonably required to provide the passage of a design flood (generally the 100-year storm event); it is also the floodway between existing levees as adopted by CVFPB or the California legislature.

In addition to designated floodways, Table 8.1 in Title 23 CCR lists several hundred stream reaches and waterways as regulated streams. Projects that would encroach on a designated floodway or regulated stream, or come within 10 feet of the toe of a state/federal flood control structure (e.g., a levee), require an application (with an associated environmental assessment questionnaire) for an encroachment permit. The Kings River Complex, Cross Creek, and the Kern River are listed in Table 8.1 and are therefore under CVFPB's purview.

CVFPB reviews encroachment permit applications for completeness and works with the applicant to ensure that all required content is submitted. CVFPB provides a copy of the application to USACE for concurrent review. In general, USACE focuses on technical engineering requirements, such as hydraulic modeling, geotechnical studies, and performance requirements to fulfill its obligations under Section 408 and Section 208.10; CVFPB focuses on environmental compliance and Title 23 standards to ensure compliance under the California Environmental Quality Act and Title 23. USACE develops a list of requirements and restrictions (e.g., maximum rise criteria demonstrated through hydraulic modeling), which append the permit. CVFPB may also develop a list of requirements and restrictions for the permit and either issue the permit with requirements and restrictions or deny the permit based on their collaborative review with USACE.

Table 1.5-3
Water Body Beneficial Uses

Water Body[1] (Name)	Tulare Lake Basin Plan Beneficial Uses[2]														303(d) Listed Pollutants
	MUN	AGR	IND	PRO	POW	REC-1	REC-2	WARM	COLD	WILD	RARE	SPAWN	GWR	FRSH	
Kings River (Peoples Weir to Stinson Weir on North Fork and to Empire Weir No. 2 on South Fork)		X				X	X	X		X			X		Electrical conductivity, molybdenum, toxaphene[3]
Cross Creek[4] (Kaweah River, Below Lake Kaweah)	X	X	X	X		X	X	X		X			X		
Tule River (Below Lake Success)	X	X	X	X		X	X	X		X			X		
Poso Creek		X				X	X	X	X	X			X	X	
Kern River (Below KR-1)	X	X	X	X	X	X	X	X		X	X		X		

Notes:
1 Features identified from review of United States Geological Survey topographic maps and aerial photographs.
2 Surface water beneficial uses identified in the Tulare Lake Basin Plan (Central Valley RWQCB 2004).

MUN	= municipal and domestic water supply	WARM	= warm freshwater habitat
AGR	= agricultural supply	COLD	= cold freshwater habitat
IND	= industrial service supply	WILD	= wildlife habitat
PRO	= industrial process supply	RARE	= rare, threatened, or endangered species
POW	= hydropower generation	SPWN	= spawning, reproduction, and/or early development
REC-1	= water contact recreation	GWR	= groundwater recharge
REC-2	= non-contact water recreation	FRSH	= freshwater replenishment

3 Kings River is impaired ~10 miles downstream of study area (from Island Weir to Stinson and Empire Weirs). After extended wet periods, Kings River conveys water to Mendota Pool and San Joaquin River (from Friant Dam to Mendota Pool), ~55 miles downstream of the study area.
4 Lake Kaweah, which provides flow to the Kaweah River and Cross Creek, is impaired ~50 miles upstream of study area.

1.5.3.3 Central Valley Flood Protection Act

California Water Code 9600 et seq.

DWR and CVFPB (which is part of DWR) collaborated with local governments and planning agencies, and prepared and adopted the Central Valley Flood Protection Plan (CVFPP) in mid-2012. The CVFPP is a requirement of the Central Valley Flood Protection Act of 2008, which establishes the 200-year flood event as the minimum level of flood protection in urban and urbanizing areas. The objective of CVFPP is to create a system-wide approach to flood management and protection improvements in the Central Valley.

Cities and counties must amend their general plans accordingly within 24 months of the CVFPP adoption; zoning ordinances must be amended within 36 months. Consequently, the 200-year flood event must be incorporated into city and county design standards by January 1, 2015, for new residential and nonresidential construction within flood hazard zones. By 2025, all urban areas protected by flood-control project levees must be protected from a 200-year flood event.

Under its Flood SAFE program, DWR is responsible for developing and making available maps for the 200-year floodplain (DWR 2008c). CVFPB collaborates with cities and counties to develop policies for implementing amended general plans.

1.5.4 Local Regulations

The cities and counties within the study area have regulations and manuals governing stormwater management for projects constructed within their respective jurisdictions. No contacts were made with

local jurisdictions during the development of this Stormwater Quality Management Report. Stormwater requirements have changed significantly at the state level, and it is expected that the requirements of the local jurisdictions will need to be modified in the near future to comply with state requirements. It is recommended that public works department officials from each of the jurisdictions be contacted and interviewed for the purpose of acquiring up-to-date information on local stormwater regulations and manuals.

1.6 Other Standards

1.6.1 American Railway Engineering and Maintenance-of-Way Association

The American Railway Engineering and Maintenance-of-Way Association (AREMA) publishes standards and best practices for railway engineering. The *Manual for Railway Engineering* is an annual publication released by AREMA. It contains principles, data, specifications, plans, and economics pertaining to the engineering, design, and construction of the fixed plant of railways (except signals and communications) and allied services and facilities. Portions of Volume One of the AREMA manual pertain to drainage standards.

Section 2.0

Hydraulic Basis of Design

2.0 Hydraulic Basis of Design

This section presents the hydraulic basis of design and reviews the following categories:

- Design flow.
- Flood capacity.
- Protection of flood control structures.
- Channel stability and scour control.
- Access.
- Seasonal construction restrictions.
- Other studies.

Various agencies have regulatory responsibility to check that the HST design adequately satisfies design requirements in these areas. Below are general design guidelines for these facilities. All designs will be refined on a site-by-site basis during later stages of design, and the owner-operators of the facilities crossed will be consulted. Note that other regulations and categories not captured in this summary may also apply.

2.1 Design Flow

The minimum required design flow depends on the type of crossing and the regulation under consideration. When more than one regulatory or project flow rate pertains, the largest design flow rate for the crossing should be used. For instance state/federal flood control projects, CVFPB, USACE, and FEMA all have jurisdiction, and the largest design flow rate of the three agencies should be selected. The categories of flow rates that require consideration include the following:

2.1.1 State/Federal Flood Control Project Authorized Flow Rate

The state/federal flood control project authorized flow rate is a project-specific flow rate and return period fixed by the authorizing legislation. Alternative or updated hydrology, such as by FEMA, would not alter the authorized design flow.

2.1.2 Federal Emergency Management Agency 100-Year Base Flood

When available, the approved base flood flow rate is defined in the most recent FIS. On smaller or rural waterways, the base flood may not have been determined previously.

2.1.3 200-Year Base Flood

Beginning in 2015, DWR will require municipal floodplain ordinances for urban and urbanizing areas to manage the 200-year base flood.

2.1.4 Canal Design Flows

Many irrigation canals in the Central Valley convey both irrigation water and municipal stormwater, typically pumped from detention basins. In most cases, irrigation districts refuse to accept stormwater.

2.1.5 Best New Hydrology

Notwithstanding authorized project flow rates, communication by the CVFPB has suggested that original hydrology should be developed to establish a new design flow rate consistent with current and projected hydrologic conditions.

2.1.6 Authority Project Minimum Design Flood

The Authority has selected minimum flood return-period objectives for natural waterway crossings based on goals to protect the critical HST facilities from flood-induced closures, delays, or damage. The California High-Speed Rail Design Guidelines (Hydraulics and Hydrology Design Guidelines 2010) summarize current project design standards.

2.2 Flood Capacity

In general, natural drainages in Central California along the HST alignment flow in a westerly direction from the mountains and foothills in the east through the low-gradient Central Valley. Shallow overland flooding tends to pond against canal berms, levees, and road embankments that cross down-gradient trajectories, unless there are adequate culverts or other means of cross-drainage flow passage. Based on FEMA floodplain maps, when stream channels exceed their banks under 100-year flow conditions, shallow flows on the order of 1 to 3 feet deep may spread out over large areas of the Central Valley. Some of this flow is impounded behind existing embankments, such as the existing BNSF alignment, with active conveyance under the embankments largely restricted to channels through bridges and culverts.

Adequate bridge openings, culverts, or siphons are important to allow for cross-drainage and prevent the HST and its new road embankments from blocking or diverting shallow flood flows. This is especially true where the CHSTP embankments form new barriers. Where the HST embankment is downstream of an existing embankment, care should be taken not to exacerbate existing flood problems. At a minimum, similarly sized and located bridge and culvert openings should be provided. However, when adjacent to undersized existing structures, current design standards must be met in the anticipation that existing structures may one day be retrofitted to improve overall conveyance. Opportunities to relieve existing capacity limitations within the HST footprint should be considered.

2.2.1 Maximum Rise and Minimum Freeboard

The minimum flood capacity at water body crossings must accommodate the design flow while maintaining the required freeboard and not exceeding the maximum rise criteria for the design-flow WSE. Freeboard is intended to allow floating debris to pass without forming a blockage or debris dam, and to accommodate potential waves and hydrologic and hydraulic uncertainty. Specific hydraulic criteria depend on the crossing classification and the regulation under consideration. When more than one set of regulatory criteria applies, the most stringent criteria should be used for design. The following sections outline the flood capacity criteria for design.

2.2.2 State/Federal Flood Control Project Authorized Flow Rate

The required freeboard between the design floodplain WSE and the lowest member of a bridge is normally 3 feet (CCR Title 23, Sect. 128.a.10.A), but it can be reduced to 2 feet at minor creeks where debris issues are minimal. Where the bridge crosses a levee, 4 feet of freeboard is normally required because (a) the normal 3-foot-minimum freeboard to the top of a levee must be increased by 1 foot "within 100 feet of a bridge" unless there is an approved risk-based analysis (Section 120.a33.A) and (b) there must be "no depression in the crown of the levee" (Sect. 128.a.17).

Where a levee is a state/federal flood control project levee, USACE should be consulted for required clearance above the levee itself. Preliminary guidance was 18 feet required clearance above the levee, but subsequent direction has indicated that zero clearance, 6 feet of clearance, or other clearance metrics may be acceptable on a case-by-case basis.

USACE requires that flow restrictions from the encroachment of piers, culverts, abutments or other project elements cause no more than a 0.1-foot rise in the project floodwater-surface elevation at any location. Exceptions to these requirements would likely require a Section 408 permit.

2.2.3 Floodplain Boundaries

CVFPB, USACE, FEMA, DWR, and other parties have mapped floodplain boundaries using best-available information, but in many cases mapped boundaries are approximate, without depth or base flood elevations provided. In the case of regulated streams without depth or base flood elevations provided, CVFPB previously indicated that the project WSE is assumed to be at or below the top of the channel (no floodplain flow). Modeling would be required to demonstrate an elevation lower than the top of the stream bank. More recent direction from CVFPB requested original hydrology and hydraulic models.

Table 2.2-1 lists the approximate limits of the FEMA 100-year floodplain crossed by the HST alignments.

Table 2.2-1
Limits of FEMA 100-year Floodplains

Alignment	Floodplain Source	Limits of FEMA 100yr floodplain (station numbers)[1]	Limit of CVFPB designated floodway	Method for determination of WSE
F1	Church Avenue	373+30 to 406+10		empirical analysis
F1	North Central Canal (add to HHD)	492+50 to 493+40		assume WSE is at top of bank
F1	Central Canal	524+00 to 525+80		HEC-RAS model
H	Kings River	1486+40 to 1623+50		HEC-RAS model and empirical analysis
HW	Kings River	1336+50 to 1501+20		HEC-RAS model and empirical analysis
HW2	Kings River	1336+50 to 1501+20		HEC-RAS model and empirical analysis
K1	Cross Creek	2375+60 to beyond end of alignment	2405+00 to 2498+80	HEC-RAS model and empirical analysis
K2	Cross Creek	2380+20 to 2585+40, 2587+20 to 2589+00	2403+80 to 2550+50	HEC-RAS model and empirical analysis
K3	Cross Creek	2414+50 to 2617+70, 2619+40 to 2621+20	2448+80 to 2583+80	HEC-RAS model and empirical analysis
K4	Cross Creek	2412+40 to beyond end of alignment	2448+70 to 2533+30	HEC-RAS model and empirical analysis
K5	Cross Creek	2375+00 to beyond end of alignment	2404+70 to 2498+20	HEC-RAS model and empirical analysis
K6	Cross Creek	2377+60 to 2582+80, 2584+60 to 2586+30	2400+20 to 2548+90	HEC-RAS model and empirical analysis
C1	Cross Creek	Before start of alignment to 2618+40		empirical analysis
C1	Tule River	2915+20 to 3041+40		HEC-RAS model and empirical analysis

Alignment	Floodplain Source	Limits of FEMA 100yr floodplain (station numbers)[1]	Limit of CVFPB designated floodway	Method for determination of WSE
C2	Cross Creek	Before start of alignment to 2611+60		empirical analysis
C2	Tule River	2858+40 to 3041+70		HEC-RAS model and empirical analysis
C3	Tule River	2915+60 to 3041+40		HEC-RAS model and empirical analysis
P		3352+00 to 3432+40		elevation/depth given by FEMA map
A1	Deer Creek	4006+20 to 4007+60, 4022+00 to 4190+20		empirical analysis
A1	Poso Creek	4713+50 to 4743+70, 4916+60 to beyond end of alignment		4713+50 – 4743+70: empirical analysis 4916+00 to end: HEC-RAS model and empirical analysis
A2	Deer Creek	4007+30 to 4009+30, 4023+60 to 4304+40		empirical analysis
A2	North County Line Creek	4449+10 to 4467+30		empirical analysis
A2	South County Line Creek	4528+50 to 4532+20		empirical analysis
A2	Poso Creek	Alignment does not enter official FEMA floodplain. However, HEC-RAS modeling results indicate that floodwater will extend to the alignment. The approximate flood limit is shown on the plans.		HEC-RAS model
L1	Poso Creek	Before start of alignment to 5261+20		HEC-RAS model and empirical analysis
L2	Poso Creek	Before start of alignment to 5261+70, 5294+20 to 5379+90		HEC-RAS model and empirical analysis
L3	Poso Creek	5170+30 to 5262+20		HEC-RAS model and empirical analysis
L4	Poso Creek	5170+30 to 5262+20, 5329+80 to 5379+60		HEC-RAS model and empirical analysis
WS1	Shafter	5976+80 to 5995+80, 5997+00 to 6031+40		elevation/depth given by FEMA map

Alignment	Floodplain Source	Limits of FEMA 100yr floodplain (station numbers)[1]	Limit of CVFPB designated floodway	Method for determination of WSE
WS1	Weidenbach Street	6166+90 to 6263+20		empirical analysis
WS2	Weidenbach Street	6146+00 to 6220+60		empirical analysis
B1	Kern River	7118+06 to 7102+27, 7094+07 to 7050+29, 7046+25 to 7021+90, 7017+81 to 7016+91		HEC-RAS model and empirical analysis
B2	Kern River	7112+85 to 7088+73, 7061+70 to 7048+54, 7043+76 to 7021+52		HEC-RAS model and empirical analysis
B3	Kern River	7112+85 to 7088+73, 7061+70 to 7048+54, 7043+76 to 7021+52		HEC-RAS model and empirical analysis

[1] Due to the recognized complex nature of flows within these floodplains, the design team carried out additional analysis to better define actual floodplain extents and floodplain depth. On the rail alignment plans, the FEMA floodplain boundaries are identified as "LIMIT OF 100YR FEMA FLOODPLAIN." The limits of the estimated 100-year flood shown on the plans are approximate, based on preliminary hydraulic modeling and empirical analysis, and identified with the name of the water body associated with the flooding, e.g., "Limit of Poso Creek Floodplain."

Due to the width of the right-of-way and the angle at which the alignment enters the floodplain, the point at which the HST alignment encounters the FEMA floodplain boundary may vary by several hundred feet across the right-of-way.

2.2.4 Federal Emergency Management Agency Base Flood Incremental Rise in Water Surface Elevation

FEMA requires restricting floodplain encroachments such that they do not cause more than a 1-foot rise in the BFE over existing conditions at any location. In some cases, a local floodplain ordinance may be more restrictive than FEMA.

2.2.5 Federal Emergency Management Agency Floodway

Zero-rise criteria applies to floodways where they have been mapped. No rise in base flood elevation is permitted if a development encroaches within the floodway itself. This is to prevent the accumulated effect of multiple projects from eventually resulting in more than a 1-foot rise in the base flood.

2.2.6 200-Year Floodplain

At the time of this report, the 200-year floodplains mapped by DWR are preliminary and do not include design flow rates or WSEs.

2.2.7 Irrigation Canals

For larger design flows, the irrigation canals should be conveyed under HST right-of-way in an open channel, under an HST bridge structure, or in a box culvert. For smaller design flows (typically less than 100 cubic feet per second [cfs]), irrigation conveyance should be piped under the HST right-of-way. If the crossing design causes a rise in the canal WSE, a minimum freeboard of 1 foot to the top of the bank should be provided along the length of the canal.

At some HST viaduct sections, the irrigation canals are required to cross the HST right-of-way in concrete box culverts to allow the HST maintenance and emergency vehicles access roads to pass through. The concrete box culverts used for irrigation canal and drainage ditch crossings will extend beyond the entire HST controlled access right-of-way.

2.2.7.1 Bridge and Box Culverts

Irrigation districts along the alignment typically require 2 feet of freeboard for bridges and box culverts. If a canal is also regulated for flood control by CVFPB, a minimum freeboard of 2 feet will be required for the crossings with limited debris potential. Additional freeboard or debris countermeasures should be provided if debris potential is high. FHWA's *Debris Control Structures Evaluation and Countermeasures HEC 9* (FHWA 2005) should be referenced in determination of the debris potential and selection of debris countermeasures.

For a bridge crossing, a minimum of 8 feet of vertical clearance is required from the bottom of the canal to allow for maintenance access for bridges. The section of canal that passes under the HST right-of-way should be concrete-lined to minimize maintenance requirements.

The culvert design must meet hydraulic conveyance requirements, provide for collection of debris via a debris rack or adequate capacity to pass the anticipated debris, and have adequate room for inspection and maintenance when dry.

2.2.7.2 Piped Conveyance

The exact design flow for piped conveyance should be discussed with the appropriate irrigation district for each crossing. The CHSTP design criteria indicate that the minimum pipe size allowable is 36 inches. Siphon pipes beneath the track could be downsized from the minimum pipe size if velocities need to be increased to prevent excessive sediment deposition within the pipe. Debris-control measures should be provided if the debris potential is high.

2.2.8 Other Requirements

2.2.8.1 Bridges

Title 23 of the CCR should be consulted for requirements that specifically pertain to bridge crossings, including topics of pier and bent placement, bridge deck drainage, construction facilities, freeboard, and maintenance considerations.

2.2.8.2 Drainage Culverts

Box and pipe culverts are provided within the HST embankment sections for drainage ditch crossings and sheet flood crossings, and as hydraulic equalization connections between floodplains or wetlands on both sides of the HST alignments.

Box culverts are designed to have a minimum freeboard of 2 feet from the 100-year WSE to the crown of the culverts. Pipe culverts are designed to have a minimum freeboard of 2 feet from the 100-year storm event WSE to the top edge of the HST subgrade. Debris countermeasures such as debris deflectors and debris racks should be provided if the debris potential is high.

2.2.8.3 BNSF

The HST structures over a waterway will be designed to have soffit elevation not lower than that of a nearby BNSF bridge. At locations where the HST is adjacent to the BNSF, the culvert passing under the HST alignment is designed to match and be tied into the existing culvert under the BNSF tracks. This design avoids the creation of a short section of open channel between the two railways, since such a feature would create maintenance and safety issues. If the existing headwall lies within the BNSF right-

of-way, permission will have to be sought to carry out construction of the culvert within the BNSF right-of-way.

2.3 Protection of Flood Control Structures

2.3.1 Culverts

Culvert inlets and outlets should be protected at crossings. Wing walls, riprap, or similar protection should be placed to protect the guideway embankment and outlet channel from possible erosion. The culvert design must meet hydraulic conveyance requirements, provide for collection of trash via a trash rack or adequate capacity to pass the anticipated debris, and have adequate room for inspection and maintenance when dry. When irrigation flows or runoff cannot be conveyed by a pipe culvert, box culverts or a bridge are required.

2.3.2 Clearance and Offset from Levees and Embankments

When crossing an existing flood control structure, such as a levee, there are minimum requirements for vertical clearance, horizontal setback, and access. The specific requirements depend on whether the structure is part of a state/federal flood control project (e.g., a project levee) or part of a local or irrigation improvement, such as a canal embankment (e.g., a non-project levee). Clearance requirements for crossings at structures include the following:

2.3.2.1 State/Federal Flood Control Project Structures

If a bridge spans a state/federal flood control project structure, such as a levee, USACE requires a minimum 18-foot clearance above the levee to provide access for emergency and maintenance equipment, but a lower clearance may be negotiated in some cases. Final requirements remain under discussion and subject to ongoing negotiations. Piers or abutments must be set back a minimum of 10 feet from the outer levee toe and up to 20 feet in some cases (Title 23). A 15-foot setback is recommended in most cases so that clearance requirements are adequately satisfied. Recently, the USACE clarified that instead of a setback, the levee could be hardened or replaced to minimize maintenance concerns, and the area completely filled in behind the hardened levee section. Exceptions to these requirements would likely require a Section 408 permit (refer to Section 2.2.2). The CHSTP design intends to minimize impacts on flood control projects and thereby allow permitting under Minor Section 408.

2.3.2.2 Non-Project Levees

CVFPB does not have a minimum clearance requirement above levees; however, local regulators should be consulted for all levee crossings.

2.3.2.3 At-Grade Approach to Non-Project Levees and Canals

As an alternative to spanning the levee with full clearance, which is typically practical only if the HST is already elevated, a spanned section of a non-project levee may be replaced with a low-maintenance, at-grade structure, such as a concrete box culvert or concrete bridge abutment. Integration of the existing levee embankment and engineered structural crossing should be properly designed to prevent levee failure or maintenance issues, and satisfy requirements of the local levee maintenance agency.

2.4 Channel Stability and Scour Control

Scour is the result of the erosive action of flowing water excavating and carrying away material from the bed and banks of waterways, and from the area around structures within the waterway, such as bridge abutments and piers. Total scour is the sum of several individual types of scour, including, but not limited to the following:

- Long-term aggradations and degradation.
- General scour.
- Contraction scour at bridges.
- Bend scour.
- Bedform scour.
- Local scour at piers and abutments.
- Thalweg scour.

Preliminary scour analyses were performed for the major waterways based on assumed sediment data, debris potential, and preliminary hydraulic modeling results. More comprehensive scour analyses will be performed in later stages of design. Sediment sampling and field investigations should be conducted to verify the location, size, and hydraulic characteristics of each waterway.

Contraction scour, bedform scour, and local scour at bridge piers and abutments were estimated per the procedure documented in *Evaluating Scour at Bridges HEC 18* (FHWA 2012). The bridge pier location and configuration are based on the HST Rail Structure Plans. Bend scour is not applicable at the waterways analyzed. The estimated scour depth in the channel should be measured from the bottom of the low flow channel to take account of thalweg scour. Potential stream lateral shifting should also be considered in an estimate of the scour depth at a specific bridge pier or abutment.

No long-term degradation was estimated as the preliminary scour analysis effort. The long-term degradation could be a significant element to the total scour and requires a comprehensive site geomorphologic study and/or a sedimentation modeling.

Potential scour at the HST bridge/viaduct crossings is expected to be in the 15- to 35-foot range for the main channels of the major rivers and creeks for a 100-year storm event, depending on the specific channel, flow, and bridge foundation dimension and configuration at each waterway.

Scour countermeasures should be selected, designed, constructed, and maintained per the procedure and methods documented in *Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance – Third Edition HEC 23* (FHWA 2009). Except for effectiveness, the selection of an appropriate scour countermeasure for the pier column and the abutment should be based on channel configuration, flow velocity and depth, construction and maintenance requirements, potential for vandalism, and costs.

The viaduct and bride foundation design should take into account the scour depth. The cap of the column should be placed at least 5 feet below grade to accommodate contraction scour and potential long-term scour. Guide bank with rock riprap or other revetment armor could be considered at the abutments to protect the HST embankment and move local scour to the upstream end of the guide bank.

2.5 Access

In general, natural waterways and irrigation channels are used for both irrigation and flood conveyance. Access is required at every crossing to allow for maintenance, flood patrols, and convenient operations.

Vehicle access from the levee crown to the floodway and/or the landside levee toe beneath the bridge may be required. Ramps may slope upstream as necessary to provide the access. Title 23 provides guidelines for patrol road and access ramp requirements.

Maintenance access will be required for irrigation/drainage canals and ditches. For the culvert crossings at the HST alignments, the existing canal or ditch access roads may be blocked by the HST right-of-way. Under these situations, it will be necessary to design the culverts with extra length to allow a maintenance vehicle to turn around at each side of the HST embankment. Generally, these culverts will be extended to have 25 feet of clearance from the face of the headwall to the HST right-of-way to allow construction of a 15-foot turnaround road. Error! Reference source not found. shows a typical concept of

a turnaround road, and the culvert length provided in Appendix B, Hydraulic Crossing Points Table, includes the extra length required for the maintenance turnaround road as necessary.

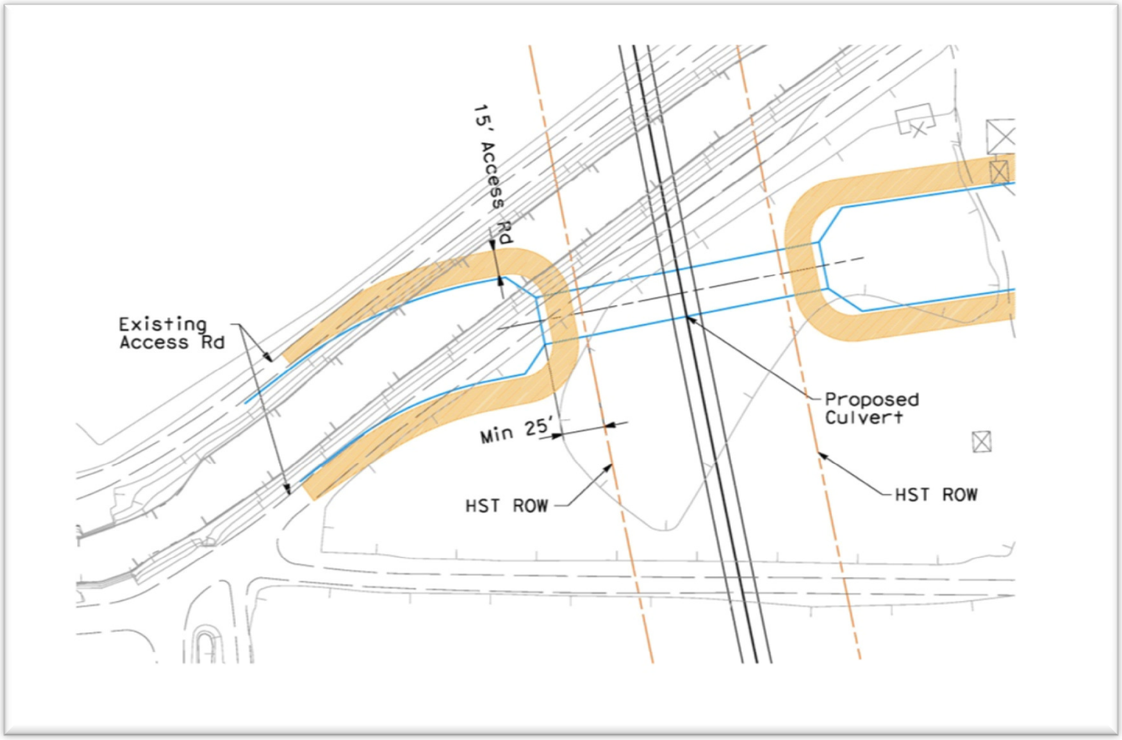

Figure 2.5-1
Concept of a Turnaround Road for Canal Maintenance Access

2.6 Seasonal Construction Restrictions

CVFPB restricts construction within the floodplain of regulated streams during the designated flood season. Title 23 provides examples of restricted activities.

Irrigation districts prohibit in-channel construction during the irrigation season, unless provision is made to maintain irrigation deliveries. The irrigation season varies with the weather and available storage, but generally begins in mid-spring (April) and extends through mid-fall (October).

Together, the flood season and the irrigation season span 12 months, so exceptions would be required. CVFPB accepts applications for exemptions to flood season construction restrictions. Irrigation districts determine exceptions to irrigation-related construction.

2.7 Other Studies

To issue encroachment permits, Section 408 permits, or building permits, agencies may require additional information, such as geotechnical explorations, soil testing, hydraulic or sediment transport studies, scour analysis, biological surveys, environmental surveys, and other analyses. The relevant agency(s) should be contacted as early as possible to confirm the specific information required for each crossing.

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Section 3.0
Project Hydraulic Crossings

3.0 Project Hydraulic Crossings

The HST alternative alignments cross existing natural and constructed water bodies including rivers, streams, and irrigation canals. This section discusses potential design concepts for water body crossings and summarizes preliminary water crossing design concepts for selected crossings.

Water bodies are crossed by both the track alignment and the associated permanent project footprint, including new roads, relocated utility corridors, and other associated project features. Culverts would be needed where new project road embankments or other elevated project facilities impede floodplain flows or cross small drainages and irrigation features such as private ditches and small canals. In some cases, roads are envisioned to provide access to land parcels where current access would be blocked by project features, and these new access roads must cross existing water bodies. Culverts developed during preliminary design are likely to be modified as private owners or local authorities decide to reroute or relocate their ditches to adapt to modified parcel configurations and access roads. Some smaller ditches may also be temporary, constructed and filled seasonally or depending on crop rotations, to facilitate relocation.

There are also locations were either the track right-of-way or portions of the permanent project footprint overlap longitudinal sections of natural and irrigation channels that parallel the project or are crossed by both the track and adjacent roads modifications over a single, continuous reach. At some locations, the permanent project footprint overlaps several hundred feet of channel. In some cases, the overlap may be eliminated during final design by refining the project footprint to avoid the water bodies. At other locations, especially irrigation channels, it may be more practical to relocate the channel outside of the project footprint.

This section describes the existing hydrologic and hydraulic condition of the waterways crossed by the proposed HST alignments, the water body crossing design concepts for major and minor crossings, and the preliminary basis of design for hydraulic crossings and road and track drainage.

3.1 Preliminary Water Body Crossing Design Concepts

This section discusses potential design concepts for water body crossings by the HST guideways. HST water body crossing designs can be broadly classified as culverts (circular conduits or concrete boxes), bridges (typified by an at-grade profile at the abutments and piers, or large box culverts in the channel), or elevated (approaches at the abutments are elevated on piers).

3.1.1 Culvert

Culverts range in size from relatively small-diameter pipe (typically 36 inches to several feet in diameter) to large precast concrete-box structures (typically 3- to 8-foot-high openings and opening widths of 5 to 24 feet). Culverts can be configured as a single conduit or as multiple parallel conduits. Culverts can be sized for a wide range of flows typical of small- to medium-size drainages or irrigation channels, with flow capacities ranging from less than 1 cfs to several hundred cfs depending on the culvert configuration, channel dimensions, channel slope, and downstream hydraulic constrictions. Each culvert or set of culverts must be sized individually based on hydrologic (runoff) and hydraulic (capacity) modeling.

In the context of irrigation canals, culverts include pipes, box structures, or inverted siphons used to pass water from an open canal headwork under the HST embankment and adjacent embankments. Where possible, a straight culvert is preferred rather than a U-shaped siphon. A straight culvert can flush out sediment and debris more easily.

Wherever possible, culverts are placed such that the tracks are normal to the channel they cross, and culverts are straight and aligned with the channel in accordance with Caltrans HDM. In order to minimize impacts on the channel, track-channel crossing angles may sometimes be less than 90 degrees but never

less than 60 degrees from the rail longitudinal alignment. The culvert design must meet hydraulic conveyance requirements, provide for collection of trash via a trash rack or adequate capacity to pass the anticipated debris, and have adequate room for inspection and maintenance when dry. When irrigation flows or runoff cannot be conveyed by a culvert pipe, open box culverts or a bridge is typically required.

3.1.2 Bridge

When a series of closely spaced culvert openings or a single span exceeds 20 feet, including intermediate supports, FHWA National Bridge Inspection Standards 23 C.F.R. 650.305 define the structure as a bridge. A typical bridge with abutments, a bridge deck, and possibly piers becomes a practical alternative to parallel precast box culverts when the required flow depth or channel depth exceeds economical box culvert dimensions or the span length requires more than three or four box culvert widths. This could result in a cost savings by using cast-in-place abutments and piers with larger heights and spans. This is true for most natural streams, rivers, sloughs, and larger irrigation canals. In the few possible instances where selection of a bridge instead of culverts is not obvious, site-specific design considerations would be evaluated to select an economical design.

Bridges are useful in spanning ravines, providing a habitat corridor, and conveying debris-laden floodwater. Hydraulic and environmental impacts are typically minimized when the bridge fully spans the water body; however, economics and practical limitations in span length typically require supporting piers or columns. Environmental or hydraulic considerations could influence the specific placement of bridge supports in the primary channel.

3.1.3 Elevated Guideway

In locations where the HST guideway is elevated, the structure crosses over the water body similar to a bridge, except without at-grade abutments. Elevated guideways are hydraulically beneficial in wide floodplains and where adequate freeboard is a concern. Elevated guideways also provide corridors for habitat. Environmental or hydraulic considerations could influence the specific placement of column supports in the primary channel.

Where the HST runs on an elevated guideway, any maintenance and emergency vehicle access roads are generally designed to run below the guideway at ground level. At locations where the guideway crosses a channel and there is no other access point for maintenance and emergency vehicles, a culvert will be installed to allow the access road beneath the guideway to continue over the channel. Where the road traverses a floodplain or other seasonally wet area, it is assumed that access to these locations may occasionally be prevented by floodwaters.

3.2 Major Waterway and Floodplain Crossings

The proposed HST alignments cross several major waterways and associated floodplains. To prevent operational interruption of the HST due to floodwater inundation and minimize impacts on the floodplains, it is necessary to bridge across these features and set the minimum soffit of HST structures above the WSEs in the floodplains.

Several methods were applied to determine the 100-year WSE, and the result from the most defensible method in each case was used for the recommended minimum soffit elevations (see Section 3.2.2). Table 3.2-1 lists the major waterways crossed by the HST from Fresno to Bakersfield, while Appendix A shows preliminary locations and types of hydraulic crossings, as well as federal project levees and designated floodways.

3.2.1 Existing Studies

Hydrologic and hydraulic information for the project area is available in the *Flood Insurance Study of Fresno County, California* (FEMA 2009a), *Flood Insurance Study of Tulare County, California* (FEMA

2009b), *Flood Insurance Study of Kings County, California* (FEMA 2009c), and *Flood Insurance Study of Kern County, California* (FEMA 2008). The FISs list 100-year flows and WSEs for Central Canal, the Kings River, Cross Creek, the Tule River, Poso Creek, and the Kern River. Additional information is available for the Kern River in a recent *Hydraulic Study Report* completed by WRECO (2010) for the City of Bakersfield Westside Parkway Project. This project is in the vicinity of the proposed HST crossing and contains a detailed hydraulic and scour analysis. Table 3.2-2 presents information from the existing studies.

Table 3.2-1
Major Waterways Crossed by HST Alignment

Waterway	Proposed HST Alignments									
	F1	**H**	**HW–HW2**	**K1–K6**	**C1–C3**	**P**	**A1–A2**	**L1–L4**	**WS1–WS2**	**B1–B3**
Central Canal	X	-		-	-	-	-	-	-	-
Kings River Complex[1]	-	X		-	-	-	-	-	-	-
Kings River[2]	-		X	-	-	-	-	-	-	-
Cross Creek	-	-		X		-	-	-	-	-
Tule River	-	-		-	X	-	-	-	-	-
Deer Creek	-	-		-	-	-	X	-	-	-
County Line Creeks	-	-		-	-	-	X	-	-	-
Poso Creek	-	-		-	-	-	-	X	-	-
Kern River	-	-		-	-	-	-	-	-	X

[1] The Kings River Complex is a reach of the Kings River that has three channels: Cole Slough, Dutch John Cut, and the Kings River.
[2] Note that the HW and HW2 Alignments cross only the Kings River channel.

3.2.1.1 Kings River Complex

CVFPB-designated floodways exist for the Kings River Complex, Cross Creek, and the Kern River. The CVFPB floodways at the Kings River Complex are within FEMA's floodplains, but no FEMA floodways have been designated for these waterways. The state floodways for Cole Slough, Dutch John Cut, and the Kings River follow the defined channels of each waterway within the FEMA floodplain, which extends from the north levee of Cole Slough to 0.7 miles south of the Kings River.

3.2.1.2 Cross Creek

At Cross Creek, both a CVFPB and FEMA floodway are delineated. The FEMA floodway narrows to fit under the existing BNSF structure across the main Cross Creek channel and is appropriately half the width of the CVFPB floodway. The CVFPB floodway boundary suggests that flood flow spills over the BNSF tracks to the north and south of the main channel.

The FIS for Cross Creek did not consider the existing extensive levees in this area because they are not certified, resulting in a wide FEMA floodplain crossing multiple levees portions of the existing BNSF tracks. In addition, the ground elevations in the FIS for Cross Creek were noted to be 10 feet higher than the HST survey data indicated. However, the FIS indicates that the 100-year flow WSE is below the BNSF bridge soffit at Cross Creek. In addition, the FIS shows that the water in the main channel is approximately 13 feet deep, which correlates to the height of the BNSF opening, according to the HST survey data.

Table 3.2-2
Available Hydrologic Study Data by Major Waterway

Waterway	DFIRM	Q3	FIS Q100 (cfs)/WSE100year (feet)	Designated Floodway Agency
Central Canal	X	X	350 / 288	-
Kings River Complex	X	X	19,900 / N/A	CVFPB
Cross Creek	X	X	19,200 / 214	CVFPB, FEMA
Tule River	X	X	20,500 / 197	-
Deer Creek	X	X	-	-
County Line Creeks	X	X	-	-
Poso Creek	X	X	19,000 / N/A	-
Kern River	X	X	10,200 / 391–395	CVFPB

FIS – flood insurance study, which includes, but is not limited to, flood histories of communities and flood profiles. See Section 3.0 for FISs referenced. WSE measured at location that the HST crosses the channel.

DFIRM – digital flood insurance rate map, which includes a delineation of 100-year floodplain boundaries (available from http://msc.fema.gov).

Q3 – Digital Q3 Flood Data, developed by scanning the existing FIRM hardcopy, without providing base flood elevations (available from http://msc.fema.gov).

3.2.1.3 Kern River

The CVFPB floodway and the FEMA floodplain for the Kern River follow the defined channel. Within the project area, the FEMA floodplain is generally confined with the north bank of Gates Canal and the south bank of Cross Valley Canal, and extends over the Cross Valley Canal at a location between Friant-Kern Canal and the Mohawk Street Bridge.

3.2.2 Hydraulic Modeling

Preliminary hydraulic modeling was performed for most of the major waterways and for each alignment alternative using HEC-RAS River Analysis System program Version 4.1.0 developed by the USACE. The hydraulic modeling was conducted based on the 15% Design Submission of the structural drawings and 100-year peak flow information documented in FEMA FISs to evaluate floodplain impacts. Table 3.2-3 lists WSE at the main channel based on the hydraulic modeling results. The potential 100-year flood boundary may be different from the FEMA 100-year flood boundary due to the limited data used for this preliminary study, the topographic data used between this study and the FEMA studies, or the approximate feature of the FEMA study for the Zone A areas.

Table 3.2-3
WSEs from the Hydraulic Modeling

Waterway	FIS Q100 (cfs)	Alignment	100-year WSE[1] (feet)
Central Canal	350	F1	289.2
Kings River Complex	19,900	H	270.6
		HW & HW2	259.1
Cross Creek	19,200	K1 & K5	202.3
		K2 & K6	202.1
		K3	204.3
		K4	204.4
Tule River	20,500	C1, C2 & C3	196.4[2]
Deer Creek	500[3]	A1	197.2
		A2	197.5
Poso Creek	19,000	L1 & L2	304.0
		L3 & L4	304.4
Kern River	10,200/15,000[4]	B1	392.9–393.7[5]
		B2 & B3	393.5–395.4[5]

[1] WSE measured where the HST crosses the main channel.
[2] The listed WSE is for the existing condition at the HST alignments.
[3] Full channel flow
[4] CVFPB 100-year peak flow
[5] WSE from CVFPB 100-year peak flow modeling

3.2.2.1 Central Canal

Central Canal is essentially a large irrigation/drainage ditch flowing east to west through Fresno. There are no levees along Central Canal. Canals within the city are owned and operated by the Fresno Irrigation District in cooperation with the City of Fresno and FMFCD. The HST alignment, F1, is proposed to cross a 170-foot-wide FEMA 100-year floodplain (Zone AE) at Central Canal with a two-barrel 16-by-6-foot reinforced box culvert. At the crossing, the base flood flow is mostly contained in the channel, with some minor flooding possible to the immediate sides of the channels.

The FEMA 100-year peak flow of 350 cfs was used for the hydraulic modeling. This 100-year flow was obtained from FEMA FIS for Fresno County, California, and Incorporated Areas, dated February 18, 2009. The channel geometry was based on the project topographic map and adjusted according to the channel bottom elevations documented in the FEMA FIS profile to account for potential error of the project topographic map affected by water depth. The hydraulic model also includes a proposed two barrel 16-by-6-foot reinforced box culvert crossing under the proposed Cedar Avenue vertical realignment, the existing northbound and southbound BNSF railroad bridges, and an irrigation flow control structure between the two proposed culverts. The geometries of the BNSF railroad bridges and the flow control structure were estimated based on field observations. Based on the hydraulic analysis, the HST impact on the 100-year WSE will not be significant (less than 0.1 feet) for both crossing locations.

3.2.2.2 Kings River Complex

Three HST alignments cross the FEMA 100-year floodplain at Kings River Complex: H, HW, and HW2. The H Alignment of the HST is proposed to cross the 13,700-foot-wide floodplain (Zone A) at its location on an 11,684-foot-long elevated viaduct and a 2,700-foot-long embankment, with other hydraulic crossings within the remaining floodplain for wildlife and floodwater passage. At the H Alignment, Kings River Complex includes Cole Slough, Dutch John Cut, and the Kings River Old Channel. There are no piers in the river at Cole Slough, but there is one pier in the center of both the Dutch John Cut and Kings River seasonal riverine areas.

At the HW and HW2 Alignments, the channel width of Kings River (outside of levee to outside of levee) is approximately 1,625 feet. The HW and HW2 Alignments are proposed to cross Kings River and the 16,500-foot-wide floodplain (Zone A) on an 8,520-foot-long elevated viaduct and embankment with small structures within the remaining floodplain for wildlife and floodwater passage. There is one pier within the boundaries of the seasonal riverine environment on these alignments.

The FEMA 100-year flow of 19,900 cfs was used for the Kings River floodplain hydraulic modeling. This 100-year flow was obtained from FEMA FIS for Tulare County, California, and Incorporated Areas, dated June 16, 2009.

The hydraulic modeling covers the existing FEMA floodplain width, extending from approximately 4,700 feet upstream of the H Alignment to approximately 6,300 feet downstream of the HW and HW2 Alignments. The maps used for the HEC-RAS modeling of the floodplain consist of project topographic maps, and LiDAR maps for areas outside the project topographic maps. Based on the hydraulic analysis, the HST impact on the 100-year WSE will not be significant (less than 0.1 feet), for both crossing locations.

3.2.2.3 Cross Creek

Six alternative HST alignments, K1 to K6, cross the FEMA 100-year floodplain (Zones AE and A) at Cross Creek. CVFPB designated a floodway for Cross Creek, which is within the FEMA 100-year floodplain limits but much wider than and encloses the FEMA floodway limits at the HST alignments. All the HST alignments were designed to cross over the CVFPB floodway on elevated viaduct and cross the remaining floodplain on embankment with small structures for wildlife and floodwater passage. A truss bridge was designed as a portion of the viaduct to cross over Cross Creek without a pier column in the channel.

At the proposed crossing, the channel width of Cross Creek (outside of levee to outside of levee) is approximately 220 feet. FEMA 100-year flow of 19,200 cfs was used for the Cross Creek floodplain hydraulic modeling. This FEMA 100-year flow was obtained from FEMA FIS for Kings County, California, and Incorporated Areas, dated June 16, 2009.

The hydraulic modeling is generally limited within the project mapping areas. The most upstream cross section is located approximately 2.5 river miles upstream of the BNSF Railroad alignment. The most downstream cross section is located approximately 2,400 feet downstream of the BNSF Railroad. Most of the cross sections extend over the FEMA floodplain, which is close to 4 miles in width at the BNSF Railroad and the proposed HST alignments.

The maps used for the HEC-RAS modeling of the floodplain consist of project topographic maps, and interpolation of the topographic contour was applied where the project maps are not available. Channel bottom elevation was adjusted based on the profile information documented in the FEMA FIS report dated September 26, 2008. Based on comparison of the structure information, it was found out that the FIS report elevations are approximately 10 feet higher than the project mapping elevations. The profile elevation information from FIS report was reduced 10 feet for use in the HEC-RAS modeling.

The modeling results show that there will not be significant change (less than 0.1 feet) in the WSE at Cross Creek for the alignments, since there will be no pier column located in the channel.

3.2.2.4 Tule River

Three alternative HST alignments, C1, C2 and C3, cross the FEMA 100-year floodplain (Zone A) at Tule River downstream of the existing BNSF railroad and State Route (SR) 43. At the proposed crossings, the channel width is less than 180 feet. The C1 and C3 Alignments were designed to cross Tule River with a 240-foot-long bridge. The C2 Alignment crosses over Tule River, a portion of the floodplain on both sides of Tule River, and the BNSF railroad with a 5,666-foot-long viaduct. There is one pier in the river for all three alignments. Due to lack of adequate topographic information, the hydraulic modeling for the floodplain was conducted in a preliminary manner and for the existing condition only. The model extends approximately 2,300 feet along the river, from 700 feet upstream of the SR 43 Bridge to 1,400 feet downstream of the BNSF railroad bridge. A 100-year peak flow of 20,500 cfs was used for the modeling. This 100-year flow was obtained from FEMA FIS for Kings County, California, and Incorporated Areas, dated June 16, 2009. Based on the modeling results, the 100-year flood will overtop the SR 43 but will pass under the BNSF railroad through the bridge and three culverts within the floodplain. No 100-year flood modeling was done for this floodplain under the proposed condition. The proposed HST alignments provide bridge and culvert openings sized to match or exceed the BNSF openings to minimize impact on the floodplain.

Additional hydraulic modeling for Tule River was conducted with a full channel flow to evaluate the impact of different pier configurations on pier scour depth. The results were provided for the structure foundation design of the proposed alignments.

3.2.2.5 Deer Creek

At the proposed A1 and A2 crossings, downstream (west) of the existing BNSF railroad, the approximately 40-foot-wide channel has short berms on both sides. The floodplain (Zones A and AO) extends along the BNSF railroad up to 13 miles, due to the flat terrain, on both the north and south sides of Deer Creek. Downstream of the BNSF railroad, there are wide gaps between the floodplain within the Deer Creek channel and the remaining floodplain. Floodwater appears to back up behind the BNSF embankment and pass through culverts south of the main channel. The A1 Alignment crosses Deer Creek and a portion of the floodplain south of Deer Creek with a 6,240-foot-long viaduct, and the A2 Alignment crosses Deer Creek and a portion of the floodplain south of Deer Creek with a 6,980-foot-long viaduct.

Due to lack of 100-year peak flow information, the hydraulic modeling has been conducted only for full channel flow analysis to evaluate the impact of different pier configurations on pier scour depth. The results were provided for the structure foundation design of the proposed alignments.

3.2.2.6 Poso Creek

Alignments L1 to L4 cross the FEMA 100-year floodplain (Zone A) at Poso Creek. The L1 and L3 Alignments were designed to cross Poso Creek with a 240-foot-long bridge with a pier in the creek. The L2 Alignment has a 6,550-foot-long viaduct, which starts from the north bank of Poso Creek and crosses Poso Creek, its floodplain on the south overbank, and the BNSF railroad. The L4 Alignment was designed to cross over Poso Creek with a 240-foot-long bridge and has a 6,620-foot-long elevated viaduct to cross the majority portion of the floodplain on the south overbank and the BNSF railroad. Both bridges for L2 and L4 have a pier in the creek.

Hydraulic modeling for Poso Creek was based on limited topographic information, including a project topographic map and contours along the existing BNSF railroad. The 100-year peak flow of 19,000 cfs was found from FEMA FIS for Kern County, California, and Incorporated Areas, dated June 26, 2008, for a location at SR 58.

The preliminary hydraulic analysis shows that for a flood of 19,000 cfs, only a small portion of the flow could pass through the existing railroad bridge at Poso Creek. The remaining flow that will be intercepted behind the railroad embankment will flow continuously north, overtopping the railroad at locations about 1 mile and 2 miles north of Poso Creek. The overtopped flow from the BNSF embankment will approach the proposed HST alignment beyond the FEMA 100-year floodplain boundary. Multiple hydraulic crossings were proposed along HST Alignments L1 to L4, as well as a south section of Alignments A1 and A2, to allow the flow to pass through.

3.2.2.7 Kern River

Three HST alignments cross the FEMA 100-year floodplain (Zone AE) at Kern River: B1, B2, and B3. All the alignments were designed to cross over the floodplain on an elevated viaduct. The viaduct is parallel to Kern River between Friant-Kern Canal and the Mohawk Street Bridge, and crosses over Kern River at a 30 degree angle. The B1 viaduct places eight piers in the river, the B2 four piers, and the B3 four piers.

Both FEMA and CVFPB 100-year peak flows were used for the hydraulic modeling. The FEMA 100-year flow of 10,200 cfs was obtained from FEMA FIS for Kern County, California, and Incorporated Areas, dated June 26, 2008. The CVFPB 100-year peak flow of 15,000 cfs is from the CVFPB Designated Floodway Program, dated September 6, 1990.

The hydraulic modeling is generally limited within the project mapping areas. The most upstream cross section is located approximately 1,270 feet upstream of the BNSF Railroad alignment. The most downstream cross section is located approximately 400 feet upstream of Coffee Road. Most of the cross sections extend over the FEMA floodplain, which is close to 4,000 feet in width at the widest location within the study area.

Based on the hydraulic modeling results, the proposed B1 Alignment will cause up to 0.23-foot rise in the channel for either the FEMA 100-year flow or the CVFPB 100-year flow, while B2 and B3 Alignments will cause up to 0.42-foot rise in the channel for the FEMA 100-year flow and up to 0.56-foot rise in the channel for the CVFPB 100-year flow.

3.2.3 Minimum Recommended High-Speed Train Soffit Elevation

In conjunction with reviewing the FISs and preliminary hydraulic modeling results, the design team conducted analyses of recent aerial topographical surveys and discussed existing conditions with the owner/operators of various roads, railroads, and irrigation/flood-control facilities within the areas of HST floodplain crossings. The comprehensive review suggests that the flood elevations may be lower than those listed in the FISs. Particularly in rural areas, the FISs reported ground elevations 5 to 14 feet higher than those determined by the recent HST topographic survey. As discussed in Section 3.2.2.3, at Cross Creek, the FIS report elevations are approximately 10 feet higher than the project mapping elevations. Subsequently, the topographic survey elevations at the floodplain edges and each waterway channel, as well as adjacent features such as existing rail and road structures, were examined.

The recommended minimum soffit elevations are based on the soffit elevation of adjacent BNSF track or the 100-year WSE plus a hydraulic freeboard for wave, superelevation, debris, and bed loading, whichever is higher. For bridge and viaduct crossings, the recommended hydraulic freeboard is 3 feet for waterways without a levee and 4 feet for waterways with a levee. For culvert crossings, the recommended hydraulic freeboard is 2 feet. The determination of the minimum soffit elevations should also consider the maintenance needs for the HST facility and the operation and maintenance needs for the waterway and the levee required by the jurisdictional agencies.

Table 3.2-4 shows the 100-year WSEs derived from the hydraulic modeling and empirical analyses for each waterway. When the derived value was not an integer, it was rounded up to the next integer. Elevations are provided for the northern and southern extents of the DFIRM floodplain and at the channel crossing. The recommend elevation of the top of subgrade supporting HST tracks on embankment within the floodplain is

the same as the minimum soffit elevation. The minimum elevations listed do not include the clearance required for the operation and maintenance of either the HST facility or the waterways and levees.

Table 3.2-4
Water Surface Elevations and Hydraulically Required Minimum Soffit/Top of Subgrade Elevations

Floodplain	HST Align.	Floodplain WSE_{100yr}[1] (North/Channel[6]/ South)	Track Elevation of BNSF Adjacent to HST Across Floodplain (North/Channel[6]/ South)	Minimum Soffit/Top of Subgrade Elevation Across Floodplain (North/Channel[6]/ South)[7]
Church Avenue[2]	F1	287/287/287	287/287/287	289/289/289[8]
Central Canal	F1	290/290/290	292/292/292	292/292/292
Kings River Complex[3]	H	272/272/272	N/A	276/276/276
Kings River[4]	HW & HW2	251/260/254	N/A	253/264/256
Cross Creek	K1 & K5	200/203/200	N/A /205/200	203/207/203
	K2 & K6	198/203/198	N/A /205/200	200/207/200
	K3	200/205/200	N/A	203/209/203
	K4	200/205/200	N/A	203/209/203
Tule River	C1, C2 & C3	196/197/195	N/A /201/200	197/201/197
Deer Creek	A1	N/A / 198 /197	200/203/ N/A	206/206/199
	A2	N/A / 198 /204	200/203/ N/A	206/206/206
County Line Creek North[5]	A2	223/224/225	228/228/230	230/230/230
County Line Creek South[5]	A2	235/235/235	240/240/240	240/240/240
Poso Creek	L1 & L2	285/304/305	296/310/309	296/310/309
	L3 & L4	285/305/305	296/310/309	296/310/309
Shafter	WS1	347/347/347	349/349/349	349/349/349
Weidenbach Street	WS1 & WS2	340/340/341	343/341/343	343/343/343
Kern River	B1	389/394/396	N/A	392/398/399
	B2 & B3	389/396/397	N/A	392/400/400

[1] Source: FEMA DFIRM compared to aerial topographic survey, field investigation, local operator consultation, and preliminary hydraulic modeling.
[2] Adjacent track is Union Pacific Railroad.
[3] Represents Kings River Complex crossing at the H Alignment. USACE project levees on Cole Slough and north side of Dutch Jon Cut (levee top elevation=272 feet). Channel represents Dutch John Cut.
[4] Represents Kings River crossing at the HW and the HW2 Alignments.
[5] County Line Creek topographic data from BNSF survey. All other waterway topographic data from HST survey.
[6] Represents main channel or center of floodplain in the case there is no defined channel.
[7] The soffit elevations are based on hydraulic considerations and do not include the clearance required for the operation and maintenance of either the HST facility or the waterways and levees.
[8] For the trench sections, the elevations are the minimum top of the trench wall elevations, not the soffit or top of subgrade elevations.

NOTE: All elevations in feet and NAVD88.

3.2.3.1 City of Fresno

The Church Avenue floodplain and Central Canal are within the urban area of the City of Fresno. The DFIRM data show that the Central Canal floodplain is generally confined to the defined channel. Church Avenue floodplain appears to be a localized depression south of downtown that fills during extreme

events due to inadequate local drainage systems. Analysis of the survey and DFIRM data suggests 100-year WSEs of 287, and 290 feet for the Church Avenue floodplain and Central Canal, respectively. When the rail alignment crosses over floodplains, the minimum elevation for the top of the trench wall is recommended to be 2 feet above the 100-year WSE or equal to the existing adjacent rail elevation, whichever is higher.

The HST is planned to be in a shallow trench through the Church Avenue floodplain. Meetings with the FMFCD have found that upstream localized improvements have been made to improve the flooding conditions in the vicinity of Church Avenue. Updated floodplain mapping has not yet been completed for the area. Retaining walls are planned to be installed to prevent floodwater from entering the trench and siphons perpendicular to the rail alignment to balance floodwaters.

3.2.3.2 Kings River Complex

The Kings River Complex at the H Alignment crossing has three project levees (both sides of Cole Slough and the north side of Dutch John Cut), which are at roughly 272 feet elevation at the point of H Alignment crossing. The DFIRM data show the project levee at the north bank of Cole Slough as the northern edge of the floodplain. Analysis of survey and DFIRM data — along with site visits and discussion with KRCD, which maintains the project levees at the Kings River Complex — suggests a maximum 100-year WSE slightly below 272 feet. With a 4 feet freeboard, the hydraulics required soffit elevation is 276 feet. KRCD has not reported levee overtopping in this area, however KRCD did indicate that there was past levee breach just north of the H Alignment. Discussions with KRCD have indicated a required maintenance clearance of 18 feet above their levels. Therefore, the minimum soffit elevation is governed by the maintenance clearance over the project levees, requiring the minimum soffit elevation to increase to 290 feet.

Kings River near the Hanford West Alignments is protected by project levees on both sides of the channel. The north bank of Kings River is shared with the south bank of Laguna Irrigation District's Grant Canal. The north and south banks are roughly 260 feet in elevation at the point of HST HW and HW2 Alignment crossing. The DFIRM data show the Liberty Ditch levee as the northern edge of the floodplain and the Riverside Ditch levee as the southern edge of the floodplain. KRCD and Laguna Irrigation District have not reported levee overtopping in this area. The minimum soffit elevation is governed by clearance over the project levees. On these levees, the maximum levee height plus 4 feet of freeboard was used to determine the hydraulics required soffit elevation of 264 feet. Discussions with KRCD have indicated a required clearance of 18 feet above their levees. Therefore, the maximum levee height plus 18 feet for maintenance access is used to determine the recommended minimum soffit elevations of 278 feet for the HW and HW2 Alignments.

3.2.3.3 Cross Creek

Analysis of the DFIRM data for Cross Creek near the BNSF structure shows the 100-year WSEs upstream and downstream of the BNSF structure to be approximately 212 feet and 209 feet, respectively. Based on the project topographic survey, these values are considerably higher than the recorded elevations of the Cross Creek levees, the existing BNSF structure, and surrounding ground surface elevations. As the project continues forward, further investigation will be required to better understand this discrepancy. An initial theory is that the DFIRM data are based on old survey information and that extensive settlement could have occurred across this portion of the project area due to excessive groundwater extraction.

To develop values for this report and the 15% design, the 100-year WSEs of Cross Creek are based on the preliminary hydraulic modeling discussed in the previous sections, which are approximately 203 feet at Alignments K1, K2, K5, and K6 and 205 feet at Alignments K3 and K4. Table 3.2-4 listed hydraulics required minimum soffit elevation for the Alignments K1 to K6. With 4 feet of freeboard, the recommended minimum soffit elevations are 207 feet for K1, K2, K5, and K6, and 209 feet for K3 and K4.

3.2.3.4 Tule River

Comparison of the topographic survey data and DFIRM floodplain delineation at the Tule River suggests a maximum 100-year WSE of 196 feet at the channel crossing, which is consistent with the hydraulic modeling that resulted in a WSE of 196.4 feet. The elevation of the adjacent ground in the vicinity of the HST crossing is approximately 195 feet. No overtopping of either BNSF or SR 43 in this area has been reported. Both BNSF and SR 43 cross over the Tule River at approximately 201 feet. This determined a minimum soffit elevation of 201 feet. The design team recommends a 15-foot clearance from the top of the levee to soffit to facility the river and HST maintenance. The recommended minimum HST soffit elevations are 213 feet at Alignments C1 and C3, and 212 feet at Alignment C2.

3.2.3.5 Deer Creek

Deer Creek on the west side of BNSF at the proposed HST crossing does not lie within its associated floodplain. The floodplain appears to be more of a local depression south of the main channel. Flood flow may pass through a culvert under BNSF, located within the floodplain, but it does not appear to exceed the capacity of the Deer Creek channel downstream of BNSF. Comparison of the topographic survey data and DFIRM floodplain delineation near Deer Creek suggests a maximum 100-year WSE of 198 feet at the channel crossing. The adjacent ground elevation in the vicinity of the HST crossing is approximately 200 feet. No overtopping of either BNSF or SR 43 has been reported in this area. SR 43 crosses over Deer Creek at an approximate elevation of 200 feet, and BNSF crosses over Deer Creek at approximately 203 feet. The design team recommends a conservative minimum soffit elevation for the HST of 206 feet at the channel crossing.

3.2.3.6 County Line Creeks

Comparison of the BNSF survey data and DFIRM floodplain delineation at the County Line Creeks suggests a maximum 100-year WSE of 224 feet at the northern creek and 235 feet at the southern creek. BNSF crosses the southern County Line Creek (the higher of the two) at approximately 240 feet elevation and the northern creek at 228 feet elevation, based on BNSF survey data. The design team recommends a conservative minimum soffit elevation for the HST of 230 feet for the northern creek crossing and of 240 feet for the southern creek.

3.2.3.7 Poso Creek

Comparison of the topographic survey data and DFIRM floodplain delineation at Poso Creek suggests a maximum 100-year WSE of 302 feet at the location of the proposed HST crossings. Hydraulic modeling results indicate a water surface elevation of 304 feet at L1 and L2 Alignments and 305 feet at L3 and L4 Alignments. There are no levees on Poso Creek, and the adjacent ground elevation in the vicinity of the HST crossing is approximately 300 feet. BNSF and SR 43 cross over Poso Creek at approximately 309.5 feet, and no overtopping of either BNSF or SR 43 has been reported in this area. However, as discussed in the previous sections, the preliminary hydraulic modeling suggested potential overtopping of BNSF at locations 1 mile and 2 miles north of Poso Creek under the 100-year peak flow of 19,000 cfs. Therefore, the design team recommends a conservative minimum soffit elevation for the HST of 310 feet at the channel crossing.

3.2.3.8 Shafter Floodplain

The Shafter floodplain appears to be a localized depression in downtown Shafter that fills during extreme events due to inadequate local drainage. Comparison of the topographic survey data and DFIRM floodplain delineation in Shafter suggests a maximum 100-year WSE of 347 feet. Approximately 4.4 miles southeast of Shafter is another localized depression centered on Weidenbach Street and Santa Fe Way. The maximum 100-year WSE is determined to be 340 feet. The design team recommends a conservative minimum soffit elevation for the HST of 349 feet for the Shafter floodplain crossing and 343 feet for the Weidenbach Street floodplain, equal to the existing adjacent BNSF track elevation.

3.3 Non-Major Waterway Hydraulic Crossings

There are approximately 400 non-major waterways along the FB Section. These waterways consist mainly of irrigation and drainage ditches. In some cases, waterways were diverted to allow for the passage of the HST. Information on the lengths and locations of these diversions can be found in Appendix C. Preliminary locations, sizes, and types of proposed hydraulic and wildlife crossings are provided in Appendix A. More information, including the location, dimensions and orientation of each of each of these facilities is listed in Appendix B. All pipe and box culverts are reinforced concrete unless otherwise noted. When hydraulic crossing facilities are required for channels or facilities under the jurisdiction of local flood control agencies, USACE, or local irrigation and conservation districts, the design of the proposed facility must be finalized through consultation with the involved agencies. The locations, types, and quantity of hydraulic crossings will be refined during future phases of the project.

Hydraulic crossings were located and sized based on three criteria:

- If the proposed HST alignment is roughly parallel to the BNSF line and a hydraulic crossing facility exists under the BNSF, then the proposed hydraulic crossing under the HST was sized equal to or greater than the existing BNSF facility (bridge width or culvert diameter), thus maintaining the existing drainage pattern and hydraulic capacity. However, when the alignment is adjacent to undersized existing structure, current design standards will be met in the anticipation that existing structures may one day be retrofitted to improve overall conveyance.
- If the hydraulic crossing of the proposed HST alignment does not occur parallel to the BNSF line, an estimate of the appropriate facility type and size was provided based on topographic survey, field investigation, discussion with local operators, and/or aerial photo.
- In locations where the proposed HST alignment and the BNSF line were not in close proximity, periodic surface flow relief culverts were added at a maximum interval of 5,000 feet along the alignment in locations shown to be in floodplains — these culverts may be necessary to allow the upstream sheet flow across (beneath) the alignment; without detailed information on local flow patterns, this interval was assumed to be conservative.

3.3.1 Wildlife Crossings

Wildlife crossing opportunities would be available through a variety of engineered structures. In addition to dedicated wildlife crossing structures, wildlife crossing opportunities would also be available at elevated portions of the alignment, bridges over riparian corridors, road overcrossings and undercrossings, and drainage facilities (e.g., box culverts, large diameter [60–120 inches] pipe culverts, and paired 36-inch pipe culverts).

Dedicated wildlife crossing structures are being proposed to provide safe passages for wildlife to cross some sections of the HST alignment. Many proposed wildlife crossing structures can serve both a wildlife and hydraulic crossing purpose in locations where flood relief for a large storm event is required.

3.3.1.1 Structure Locations

Dedicated wildlife crossing structures will be provided from approximately Cross Creek (Kings County) south to Poso Creek (Kern County) in at-grade portions of the HST embankment at approximately 0.3-mile intervals. Additionally, dedicated wildlife crossing structures would be placed to the north and south of each of the following river/creek crossings: Kings River, St. Johns Cut (Dutch Slough), Cole Slough, Cross Creek, Tule Creek, Poso Creek, Deer Creek, and Kern River. These wildlife crossing structures would be located between 100 and 500 feet from the banks of each riparian corridor.

Where bridges, aerial structures, and road crossings coincide with proposed dedicated wildlife crossing structures, such features would serve the function of, and supersede the need for, dedicated wildlife

crossing structures. Appendices A and B provide the dedicated wildlife crossing structure locations. Project design plans will be further refined to identify optimal wildlife-friendly crossing locations to maintain or enhance crossing, dispersal, and migration opportunities for wildlife across the HST alternatives.

3.3.1.2 Structure Configurations

The preliminary wildlife crossing structure design consists of modified culverts in the embankment that would support the HST tracks. The typical culvert from end to end would be 73 feet long (crossing-structure distance), span a width of approximately 10 feet (crossing-structure width), and provide 3 feet of vertical clearance (crossing-structure height), resulting in a calculated openness factor (Bremner-Harrison et al. 2007) of 0.41([Height × Width]/Distance = Openness Factor; [3 feet × 10 feet]/73 feet = 0.41). To accommodate variations in the topography, the height of the at-grade profile may require depressing wildlife crossing structures, which could be no more than 1.5 feet (half of the vertical clearance) below-grade.

At locations where stormwater swales parallel the embankment, the approach to wildlife crossing structures would be designed in such a way as to minimize the amount of surface water runoff entering the structure. A small berm (or lip) would be located at the entrance of the wildlife structure to prevent water from entering during small storm events. Swales will be discontinued at this lip. To allow wildlife free passage through the crossing structures, HST right-of-way fencing would be constructed at the toe of the slope, up the embankment, and around the entrance of the structure. At locations where an intrusion protection barrier parallels a proposed wildlife crossing structure, the crossing structure would be extended and designed to pass through the barrier to allow wildlife free passage. Figure 3.3-1 shows the wildlife crossing elevation and cross section, as well as the drainage detail.

Additional wildlife crossing structure designs could include circular or elliptical pipe culverts, and longer culverts with crossing-structure distances up to 100 feet. However, any changes to wildlife crossing structure design must be constrained by a minimum of 3 feet of vertical clearance (crossing-structure height), depressed no more than 1.5 feet (half of the vertical clearance) below-grade, and must meet or exceed the minimum 0.41 openness factor.

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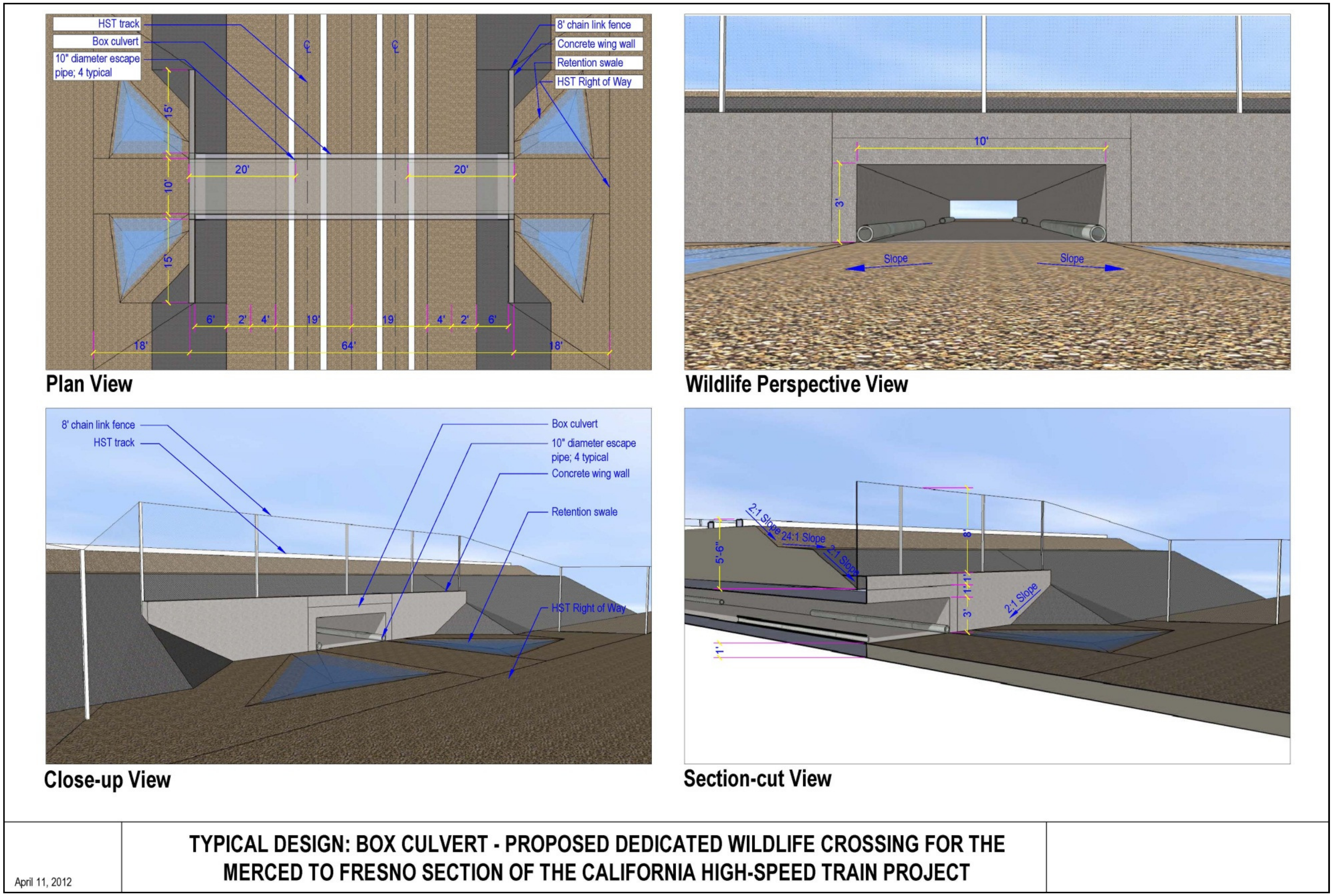

Figure 3.3-1
Typical Design: Box Culvert Wildlife Crossing

Section 4.0
Drainage

4.0 High-Speed Train Track and Road Drainage Concepts

This section discusses general drainage design criteria for the proposed CHSTP alignment and adjacent facilities, including frontage roads and road crossings. HST drainage systems will collect, convey, and discharge surface runoff from HST right-of-way in a safe and controlled manner through a network of pipes, channels, bridges, and culverts, and accommodate existing watercourses as appropriate.

New drainage facilities may incorporate vegetation or gravel linings of ditches/channels/basins to control erosion and decrease velocities, as well as vegetation of exposed cut-and-fill slopes to prevent slope face erosion. Erosion control and water quality is discussed in further detail in the *Stormwater Management Report*. The implementation of these designs will be considered for each individual drainage facility; in some cases, however, it may not be feasible to provide some or all of the items.

4.1 High-Speed Train Track Drainage

This section discusses drainage design for the tracks and structures along the proposed HST alignment. Four categories of track drainage are discussed: drainage of rail on embankment, rail on retaining wall, rail in trench section, and rail on elevated viaduct. In rural areas, the proposed HST is generally on embankment. In most urban areas, the proposed HST will be primarily on embankment with short lengths of track below grade in a grade separation section and above grade on structure as necessary. There will be minimal impact to local urban drainage systems because the HST will not significantly increase the overall impervious surface area.

4.1.1 Drainage of Rail on Embankment

The footprint of the HST embankment will depend on the height of the tracks at a given location, and could be up to 100 feet wide in constrained locations or greater than 100 feet in locations where the right-of-way is not constrained. The side slopes of embankment sections will be no steeper than 2H:1V. The track subgrade will have a crown to facilitate drainage. Stormwater will be discharged and infiltrate in drainage swales along the toe of each side of the embankment within the HST right-of-way. In urban areas, these swales may connect to local drainage systems where appropriate. All concentrated flow will be addressed in a non-eroding manner.

4.1.2 Drainage of Rail within Retaining Wall Section

Tracks placed on sections of alignment supported by retaining walls will feature weep holes near the base of the wall to prevent the buildup of stormwater within the embankment. Trackbed drainage will be collected in a closed, piped drainage system. Periodic storm drains may also be incorporated behind the top of the retaining walls to accommodate peak events. All concentrated flow will be addressed in a non-eroding manner.

4.1.3 Drainage of Rail in Trench Section

Tracks set below grade will have drainage systems to collect stormwater and direct it to a pump station. Stormwater will be pumped to the original ground outside the trench and released into a drainage facility.

4.1.4 Drainage of Rail on Viaduct

The viaducts generally have 120-foot-span concrete box girders approximately 50 feet wide with one or two columns per bent. The proposed viaducts generally pass through areas within cities that are at least partially covered with impervious surface, which will remain after project completion; therefore, the increase in impervious surface due the HST viaduct will be minimal.

Stormwater will be collected from the tracks and drain to the ground through downspouts at the columns. Downspouts may not be required at each column; spacing will be provided in future design

stages. The downspouts would discharge to a detention basin, convey flows to a nearby stormwater collection system, or deliver the water into swales underneath the viaduct that would serve as detention basins and, within rural floodplains, allow the water to soak away.

4.2 Roadway Drainage

HST construction will require existing roads and highways to be rerouted and, in some cases, new roads to be constructed. In all cases, every effort is made to maintain existing drainage patterns and minimize net increases to impervious surface.

There are many road crossings along the proposed HST alignments. Each road crossing will be handled in one of three ways, each requiring a unique drainage approach:

- The road crossing will become an overpass above the HST alignment.
- The road crossing will become an underpass beneath the HST alignment at-grade.
- The road crossing will be closed or rerouted to an adjacent roadway.

4.2.1 Overpass Drainage

A roadway overpass is the most common solution to maintaining sufficient traffic patterns from one side of the HST to the other. The overpasses will slightly increase the impervious area because of the lengthening of the paved surface compared to the existing at-grade roadway.

The basic drainage method that will be employed is stormwater collection at the toe of the embankments of overpasses in linear or more pond-shaped detention basins, depending on site constraints. The linear basins may have up to a 10-foot-wide base, 4H:1V side slopes, and sufficient depth to provide 1 foot of freeboard. The basin lengths will vary between 400 and 1,000 feet. Pond-shaped basins also would have 4H:1V side slopes and sufficient depth to provide 1 foot of freeboard.

Stormwater runoff conveyance may tie into existing nearby storm drain systems. If such tie-ins are available, the capacity of the systems will be analyzed during design.

4.2.2 Underpass Drainage

An underpass is proposed when the HST is on embankment and a road can be passed underneath. The net increase in impervious surface, and therefore stormwater runoff, will be minimal. It is not anticipated that the pump would operate on a regular basis. Regardless, underpasses will require pump stations that will pump runoff out of the low point of the road to either a municipal drainage system or detention basin. The underpass drainage and pump system will be designed per state and local standards as appropriate.

4.2.3 New Road Drainage

Several rail crossing improvements will require new paved access or frontage roads. In most cases, proposed new roads are in rural areas, and stormwater will run off into roadside ditches and typically infiltrate. In more urban cases, runoff will flow to an existing storm drain system.

4.2.4 Road Closures

Road closures reduce the impervious surface footprint and, therefore, the amount of stormwater runoff. Where a road closure is planned, consideration will be given to maintain the existing drainage patterns.

Section 5.0
References

5.0 References

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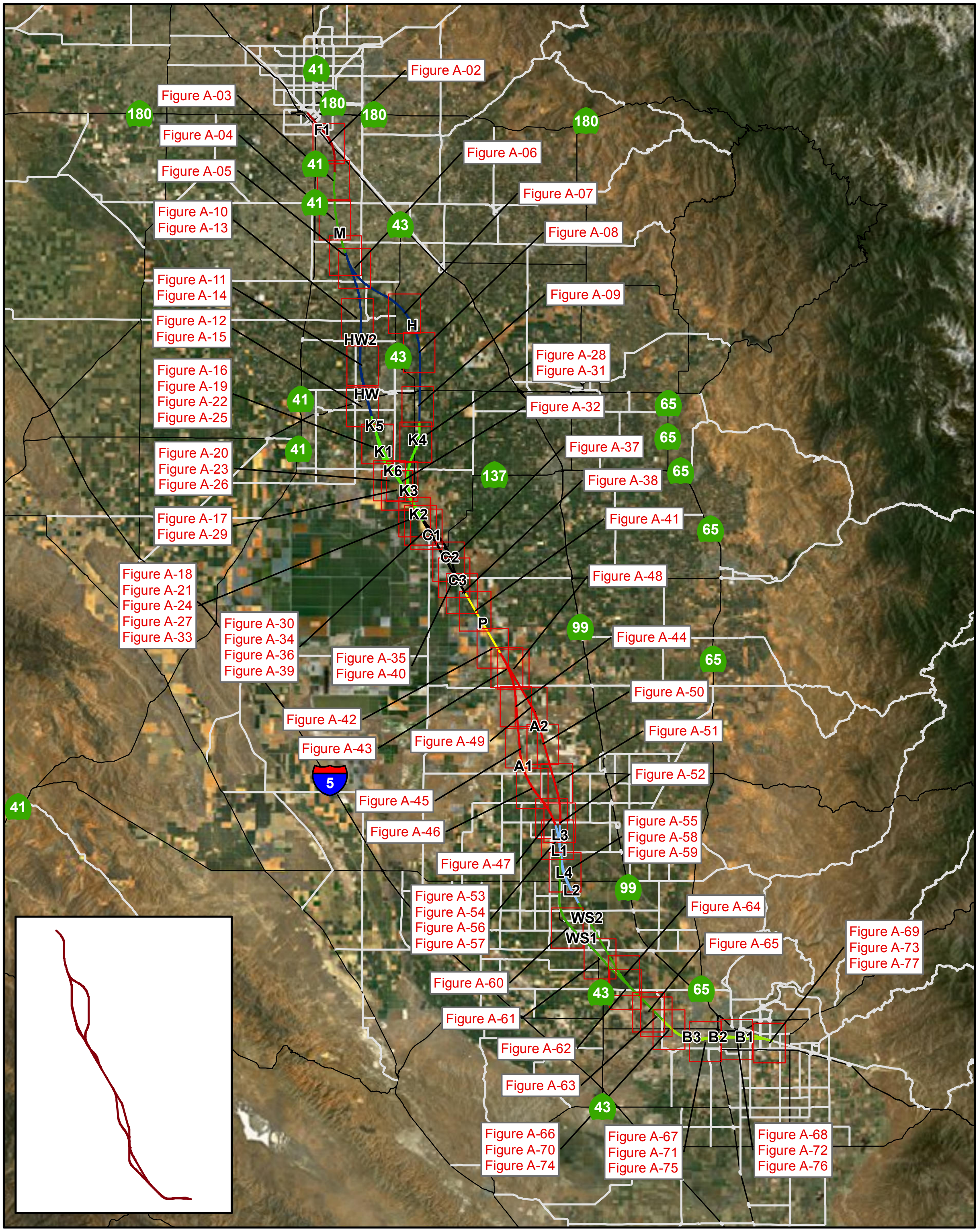
Appendix A
Hydraulic Crossing Points Figures



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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CVFPB Designated Floodways

Hydraulic Crossing Point

Alignment Alternatives

- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

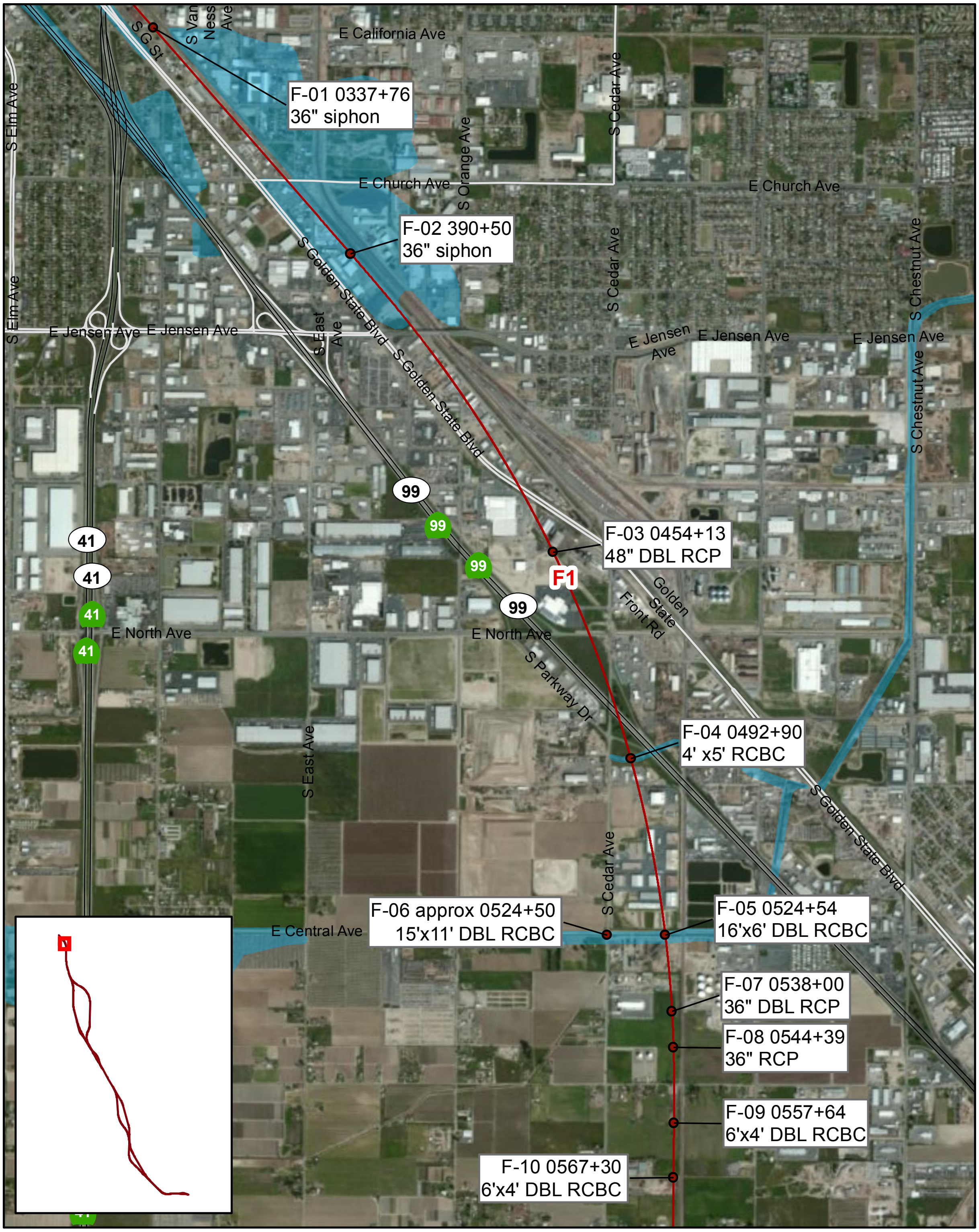
N

0 37,000 74,000
Feet

0 14,000 28,000
Meters

Figure A-01

Hydraulic Crossing Points Key Plan



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013

N

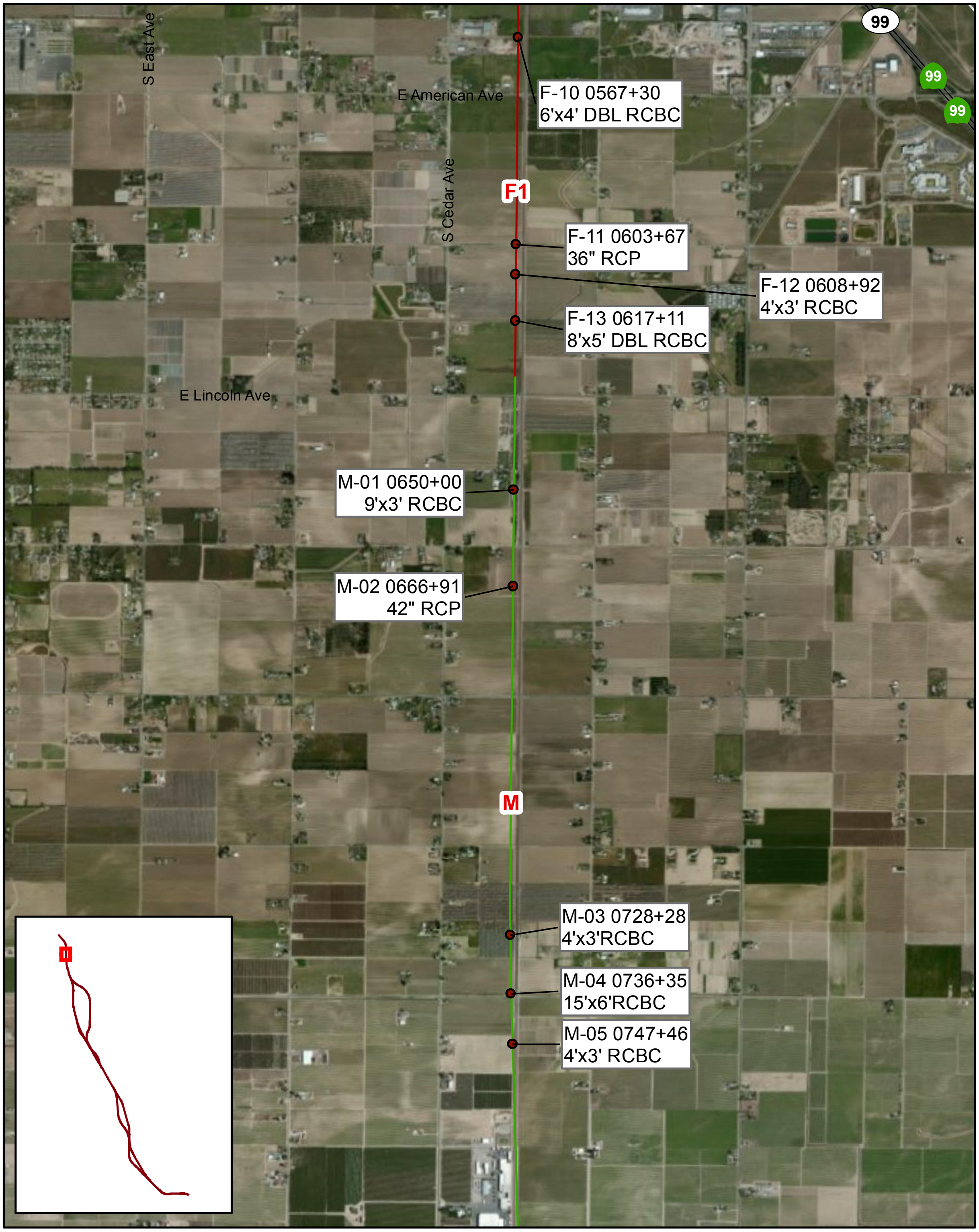
0 1,250 2,500
Feet

0 500 1,000
Meters

- CVFPB Designated Floodways
- Hydraulic Crossing Point
- 100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

Figure A-02
Hydraulic Crossing Points



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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013

N

0 1,250 2,500
Feet
0 500 1,000
Meters

CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

Figure A-03
Hydraulic Crossing Points

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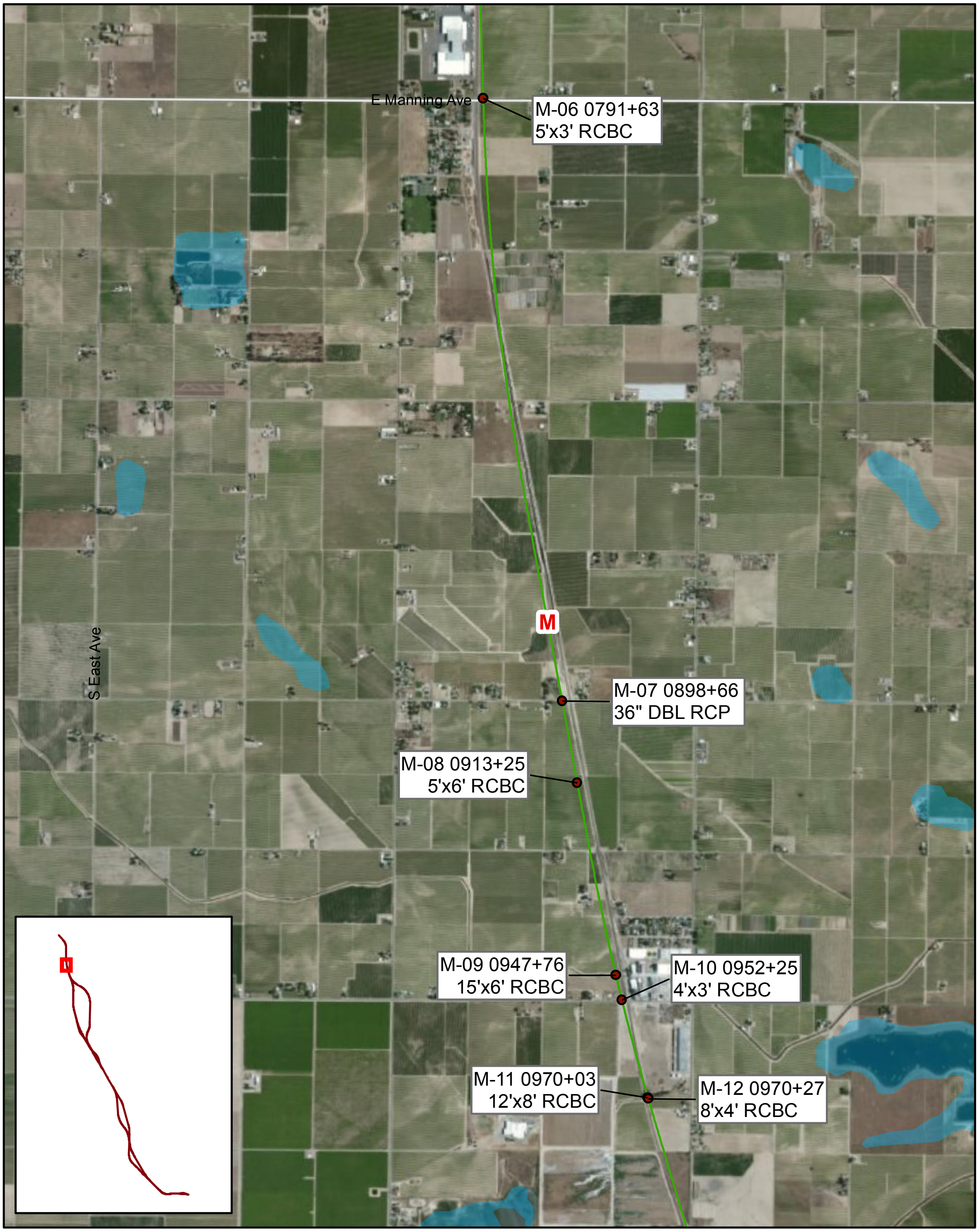

Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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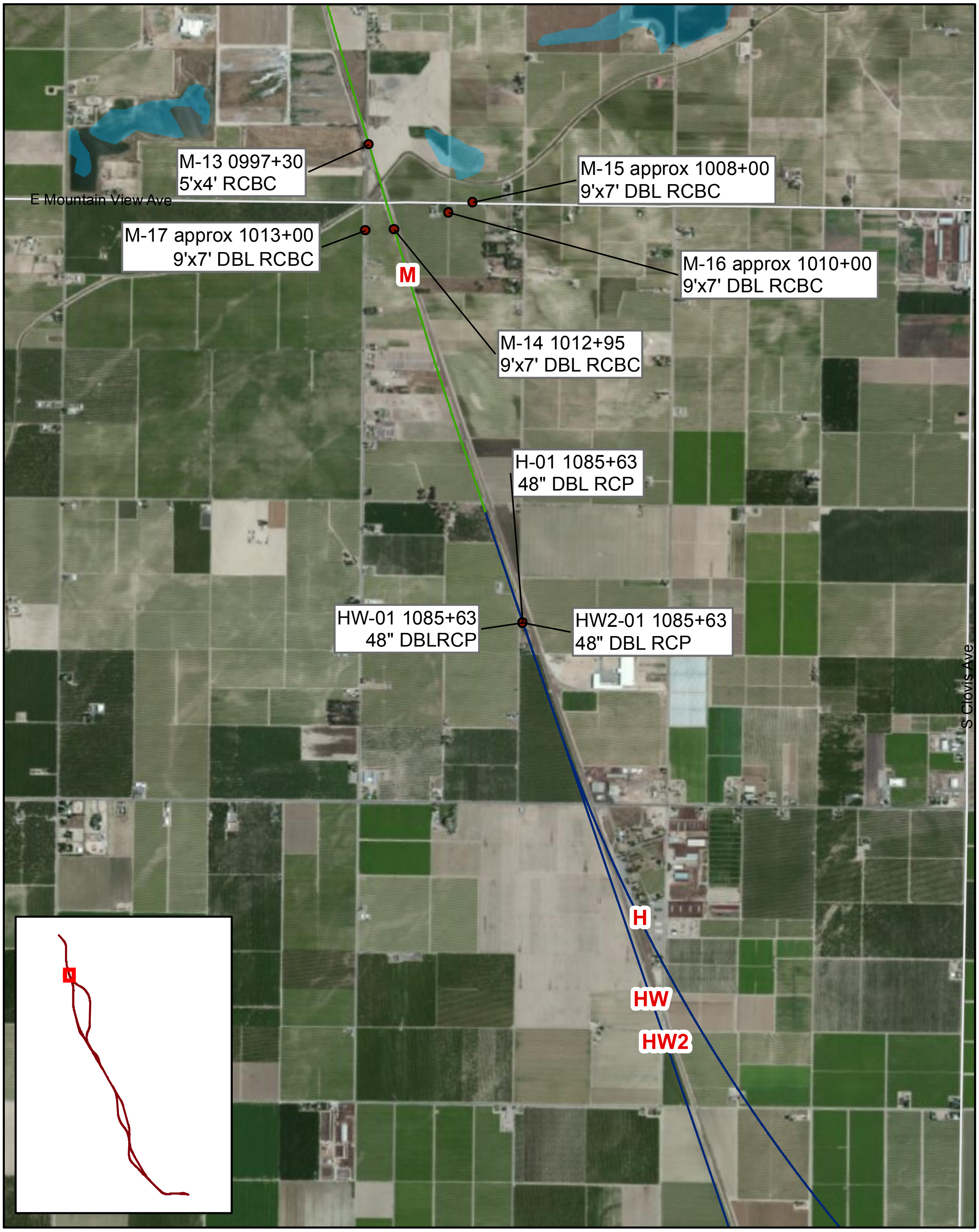
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-04
Hydraulic Crossing Points



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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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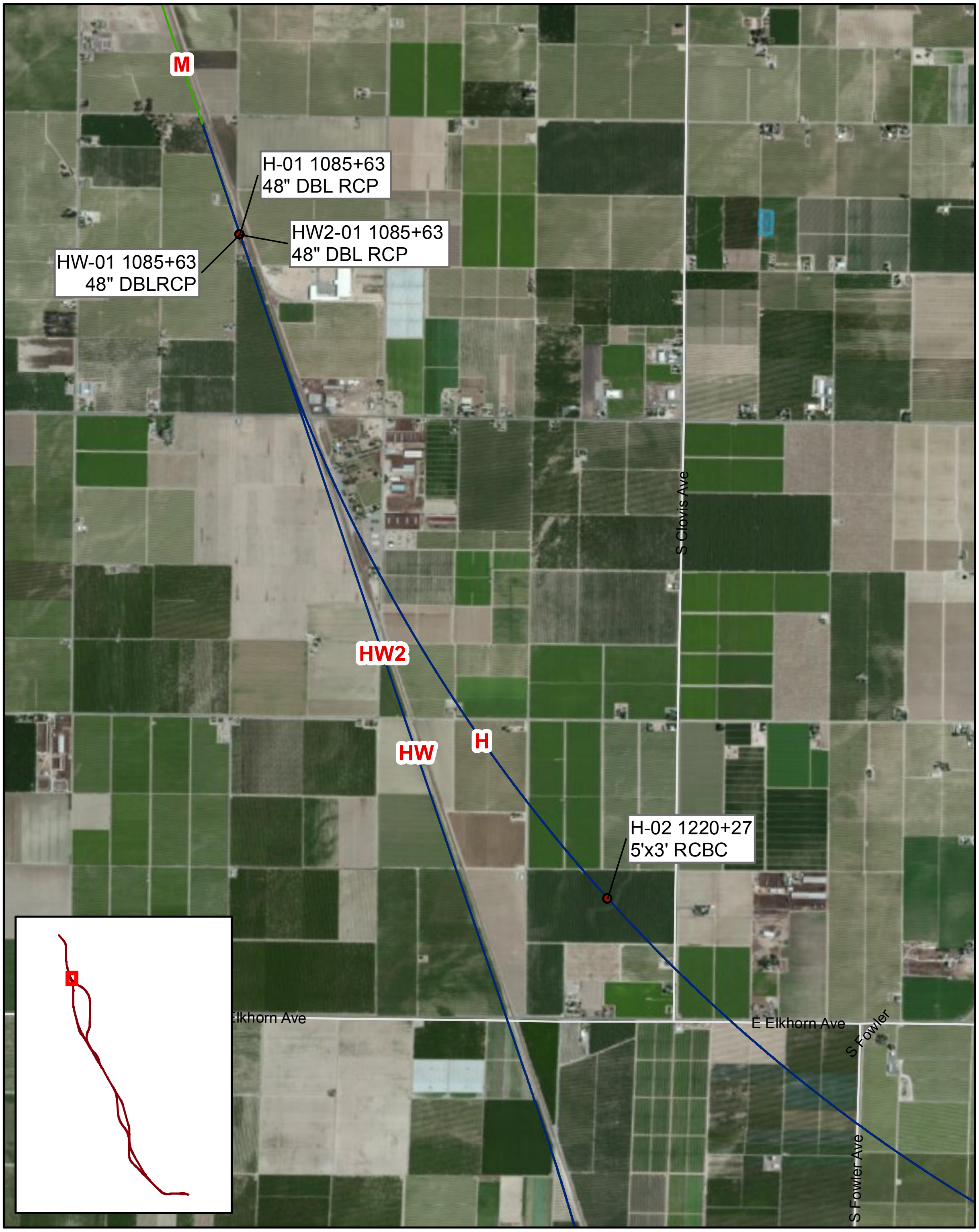
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-05
Hydraulic Crossing Points



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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-06
Hydraulic Crossing Points

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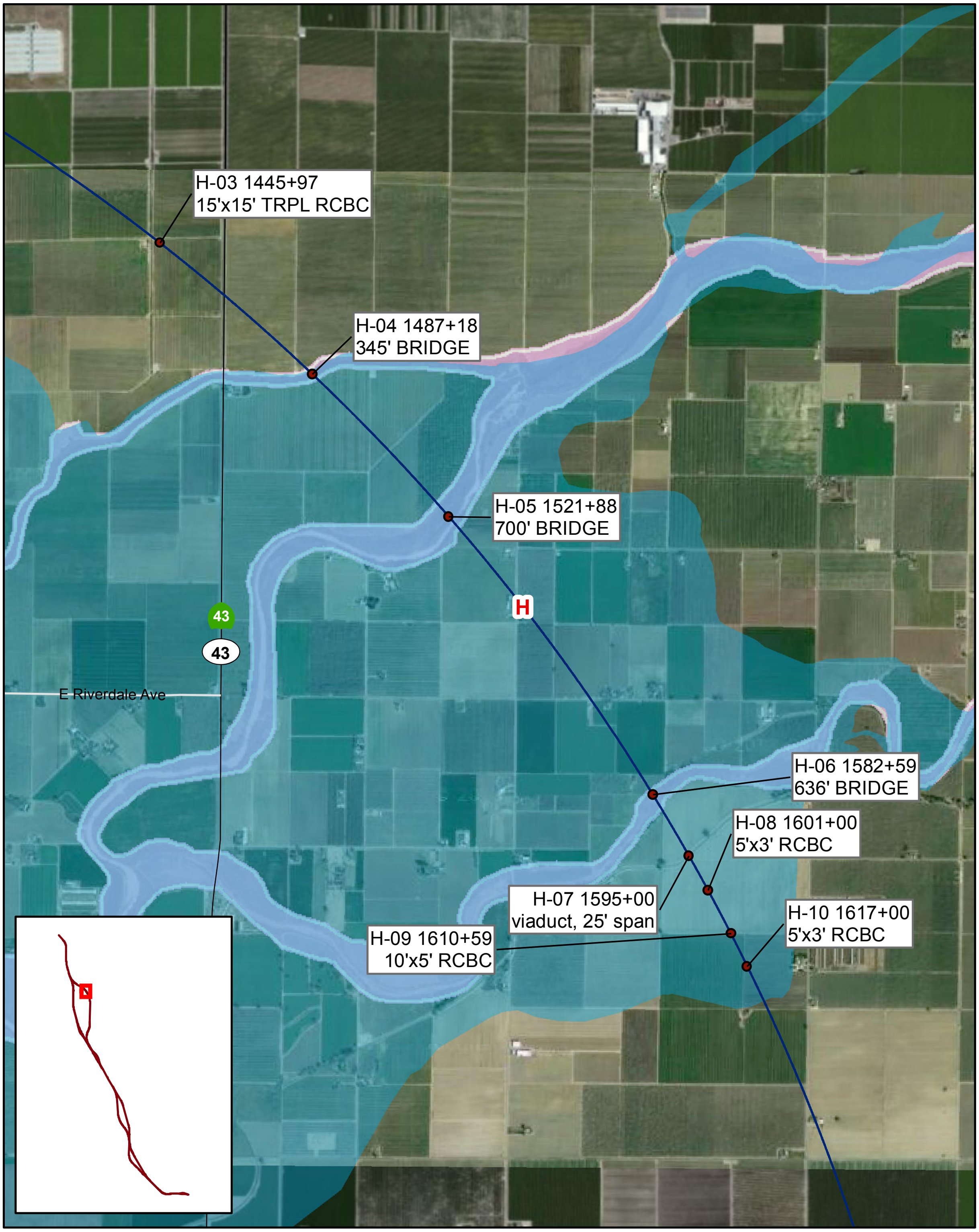

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CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-07
Hydraulic Crossing Points

Source: Flood zone - FEMA DFIRM
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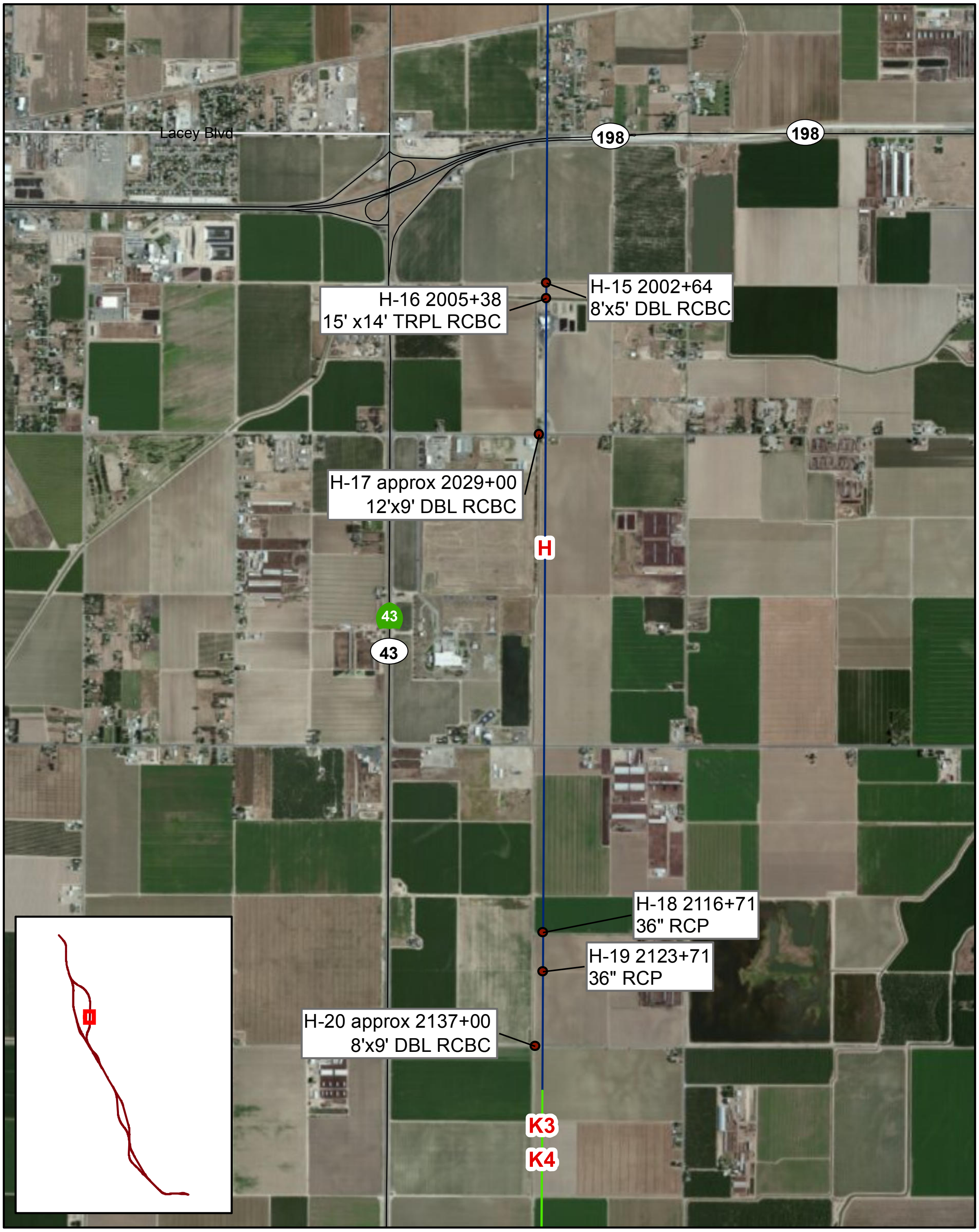
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-08
Hydraulic Crossing Points



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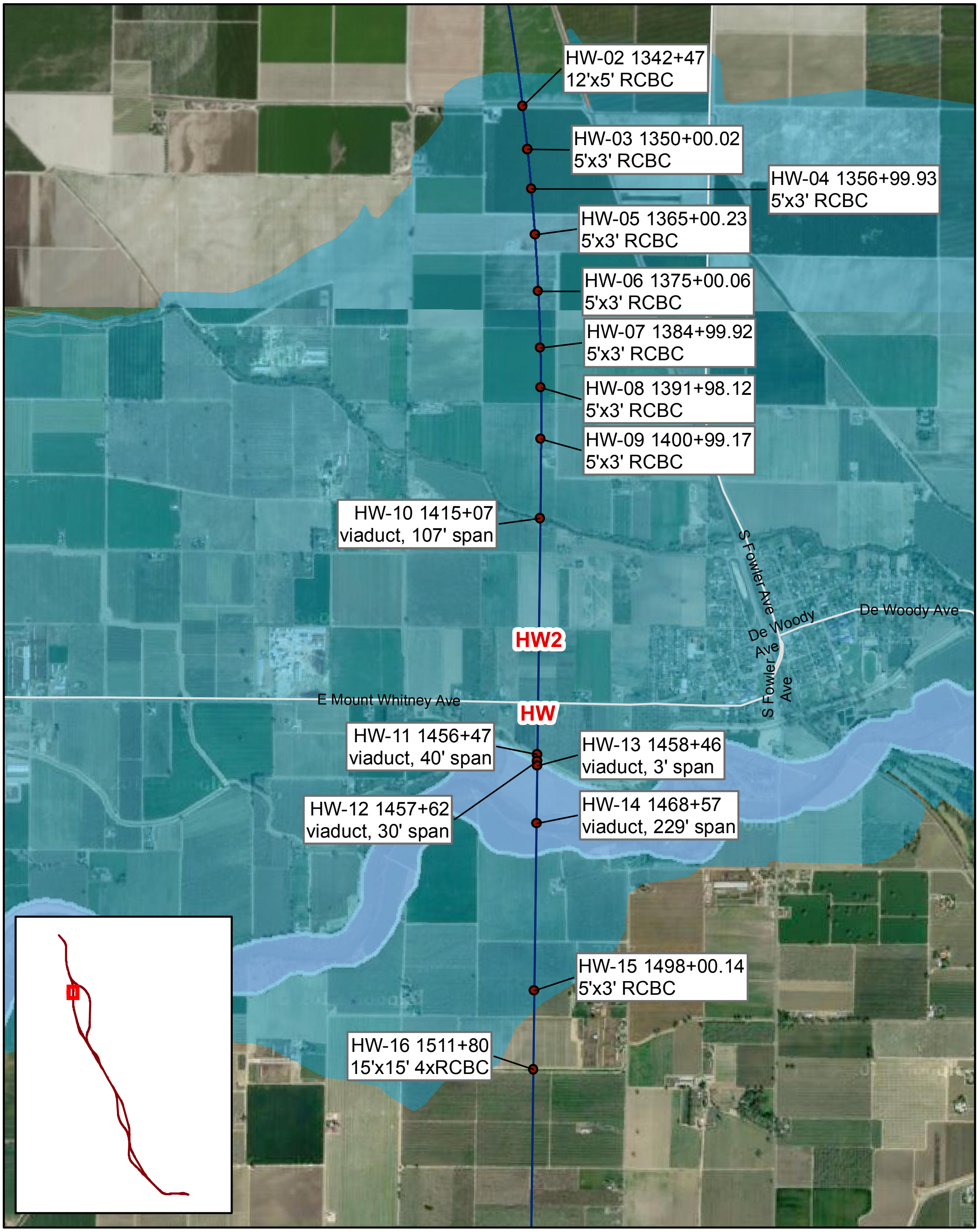
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-09
Hydraulic Crossing Points



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CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

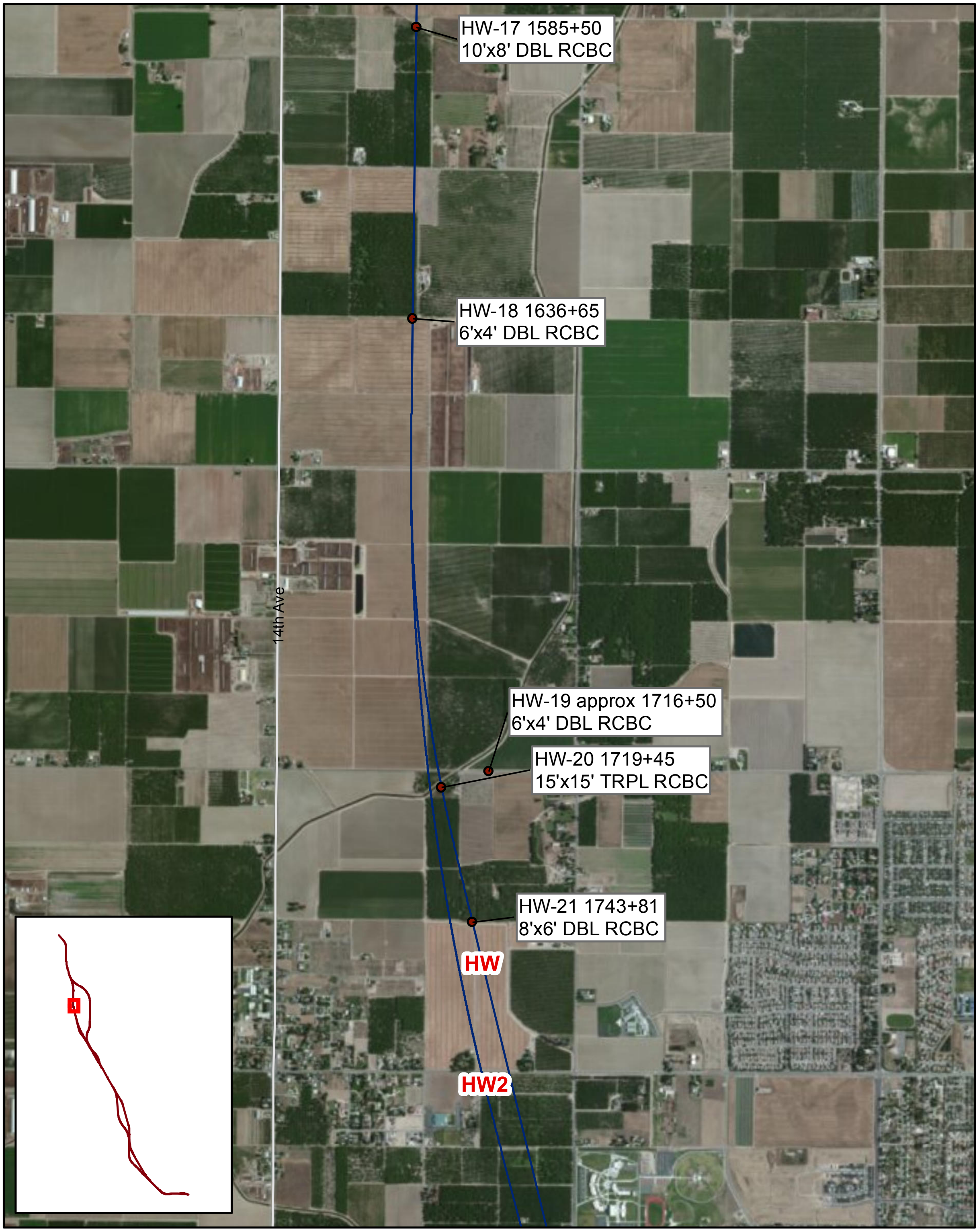
Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet

0 500 1,000
Meters

Figure A-10
Hydraulic Crossing Points



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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-11
Hydraulic Crossing Points

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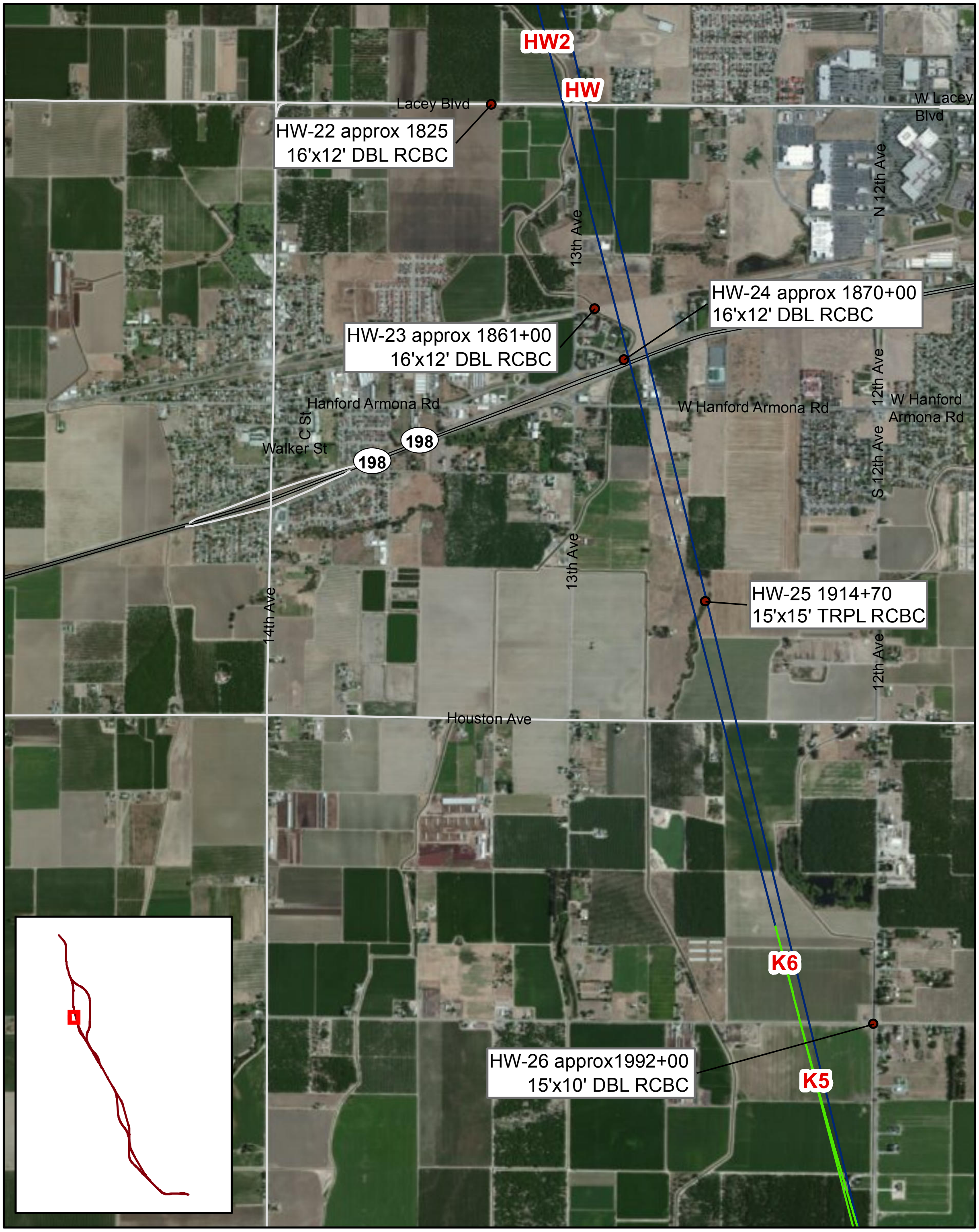

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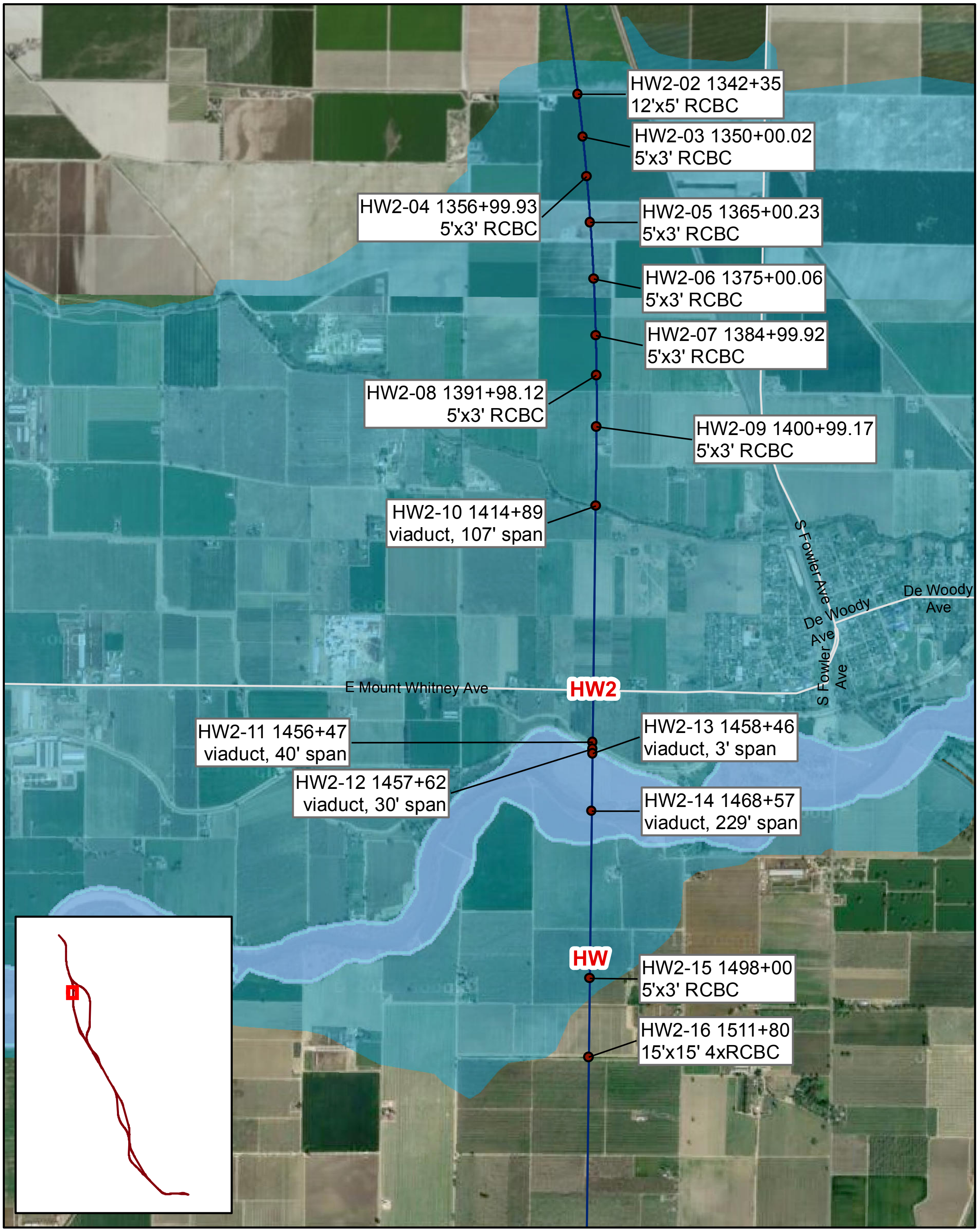
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-12
Hydraulic Crossing Points



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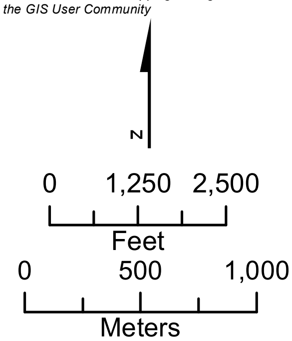
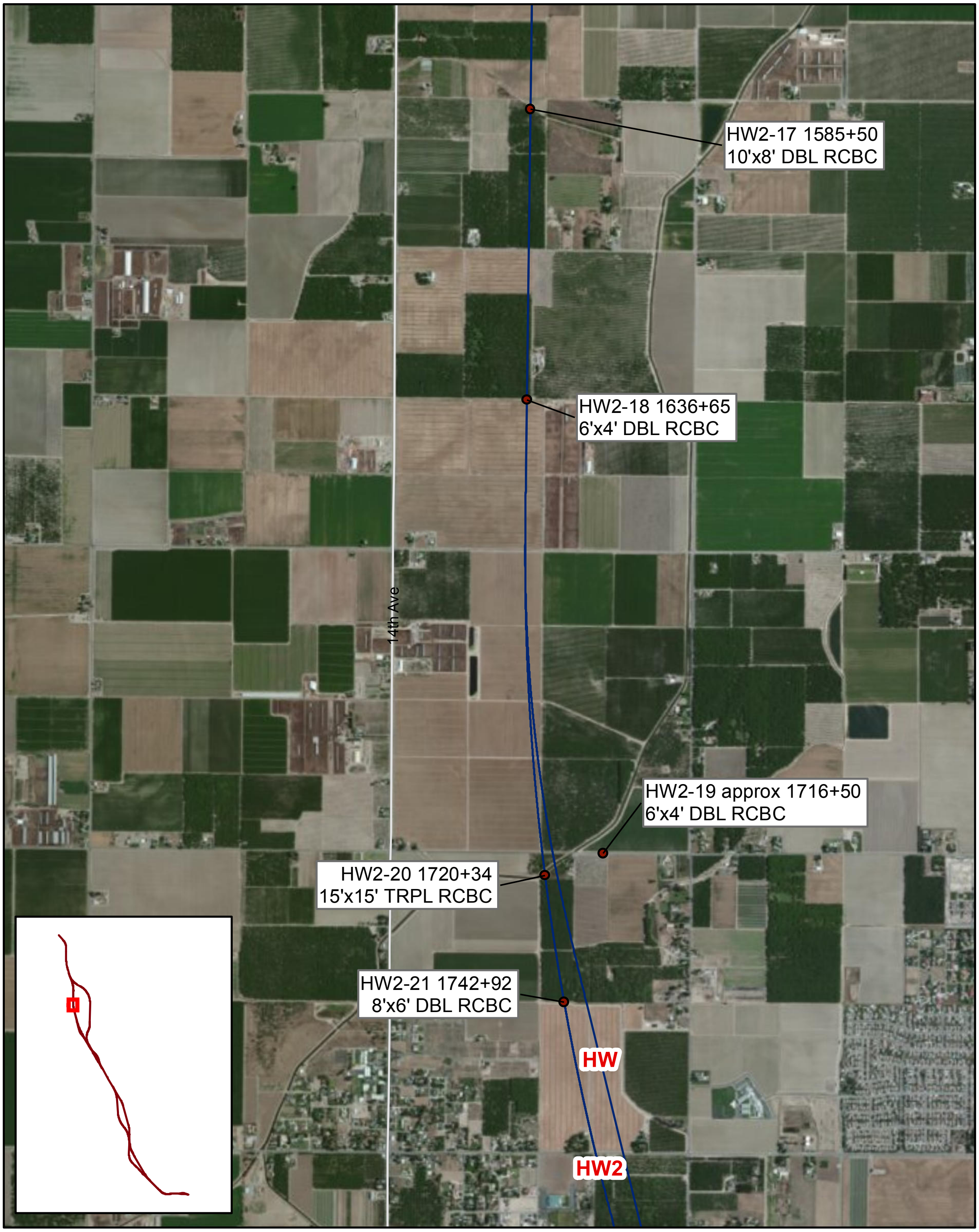


CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

Figure A-13
Hydraulic Crossing Points



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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013

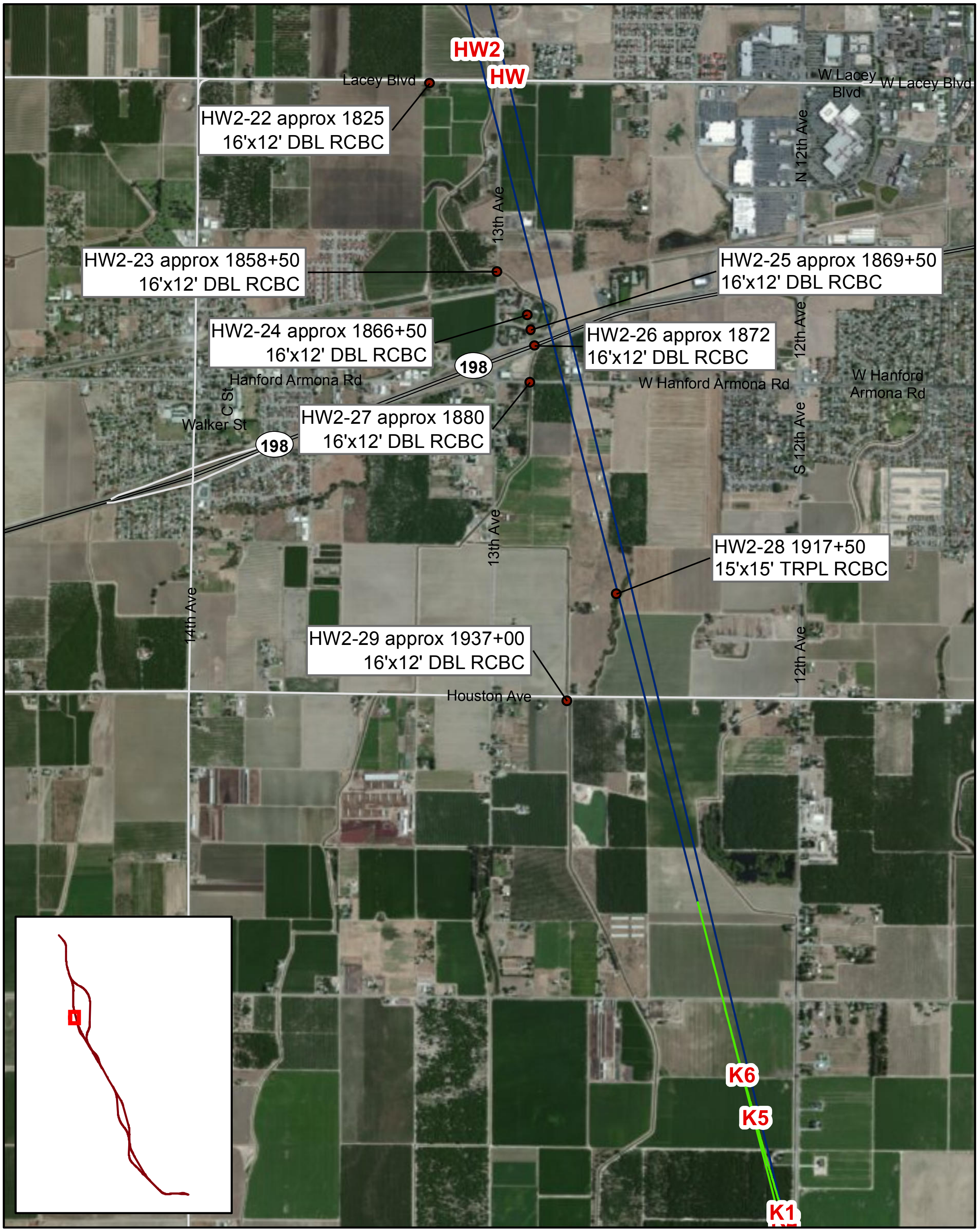
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-14
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013

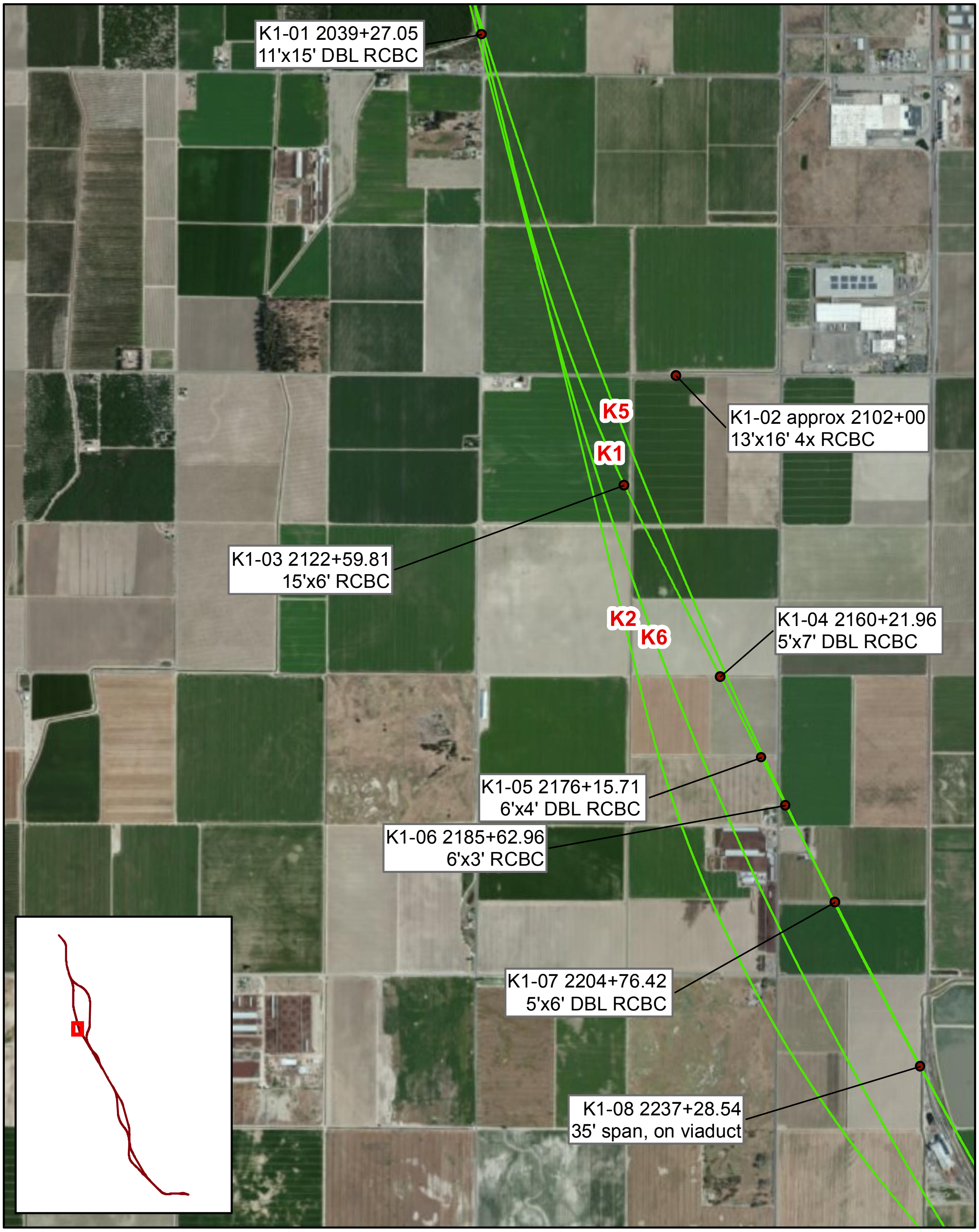
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-15
Hydraulic Crossing Points



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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013

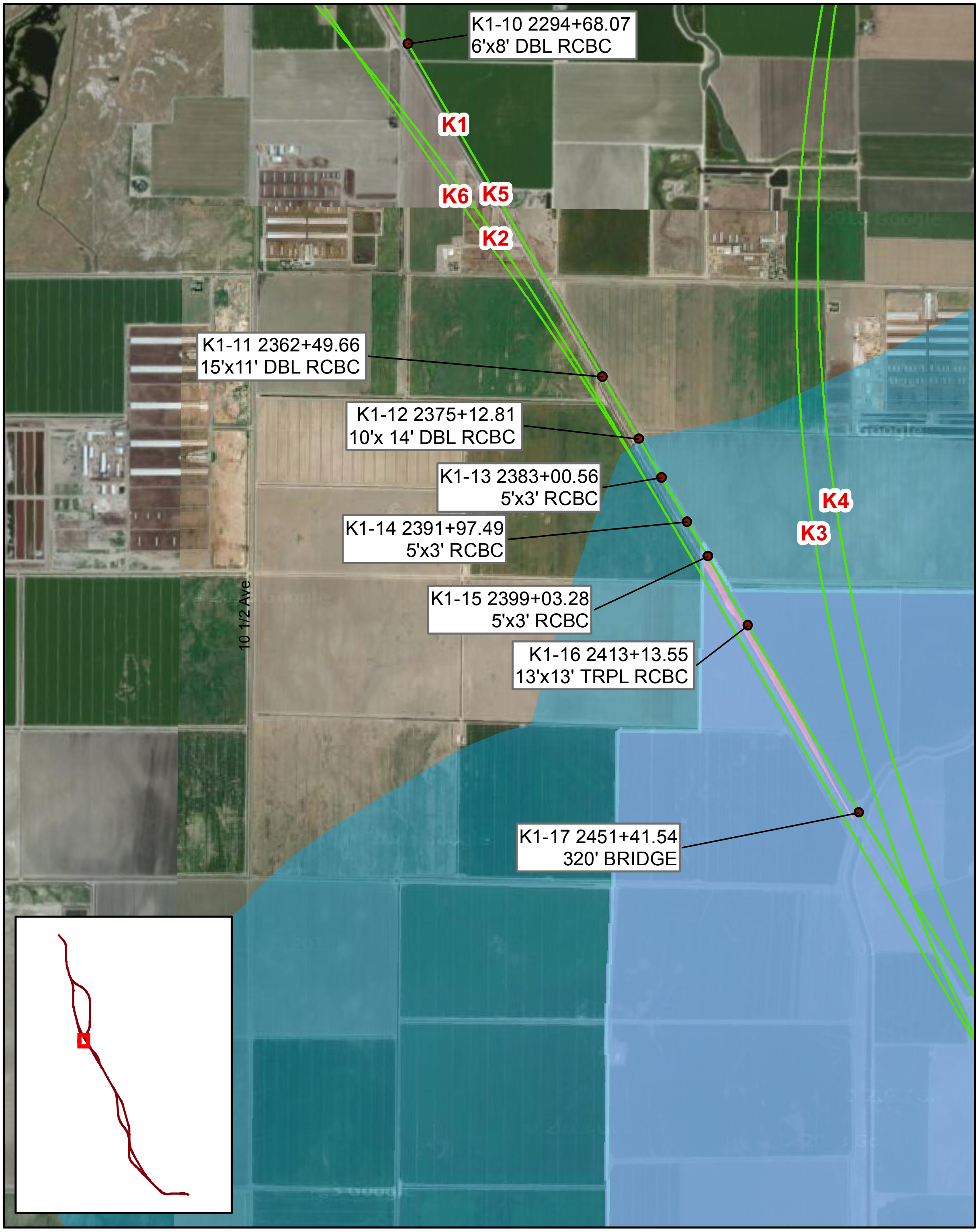
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-16
Hydraulic Crossing Points



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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013

CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

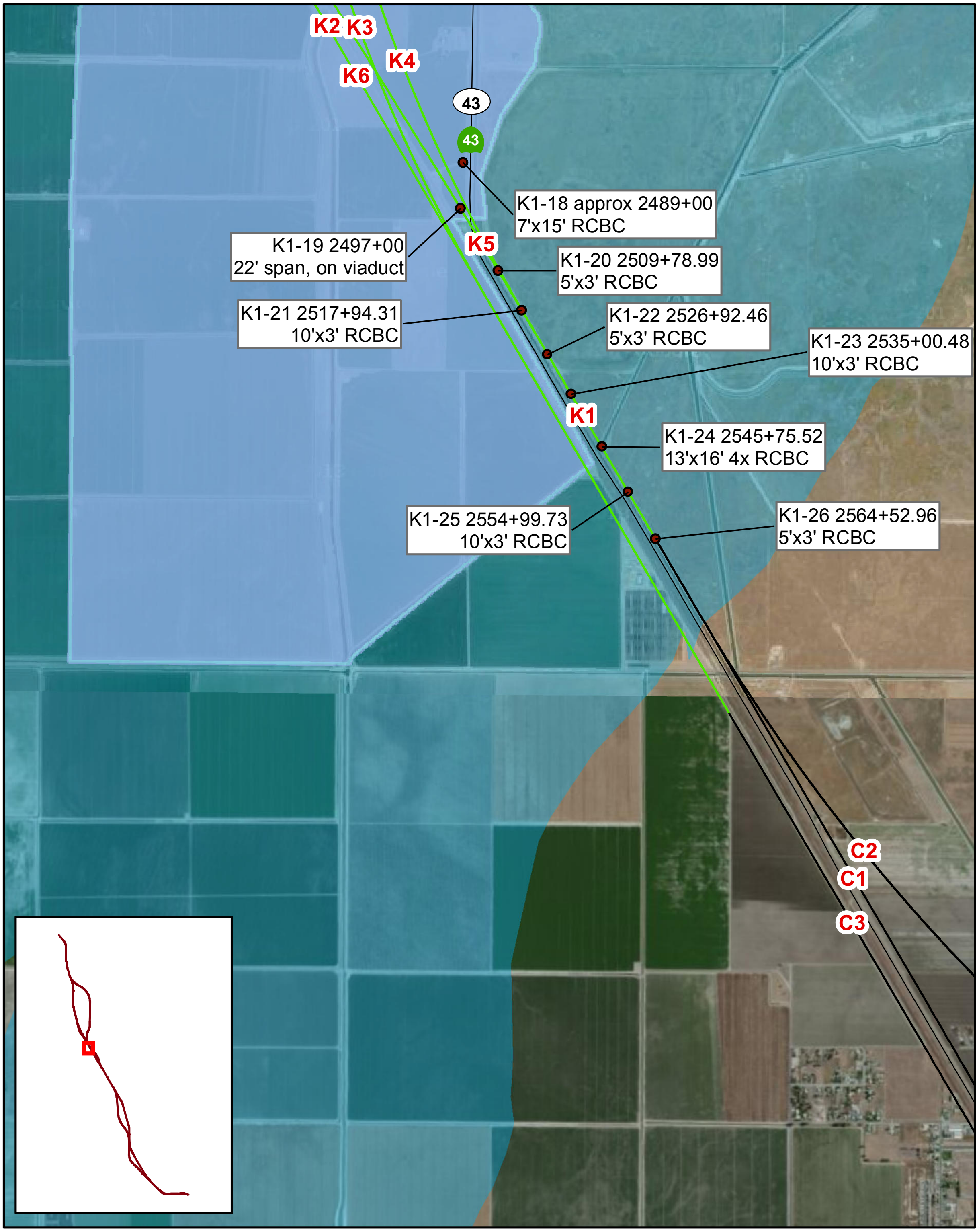
Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-17
Hydraulic Crossing Points

RFP No. HSR 14-32 – INITIAL RELEASE - 05/27/2015



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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013

CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

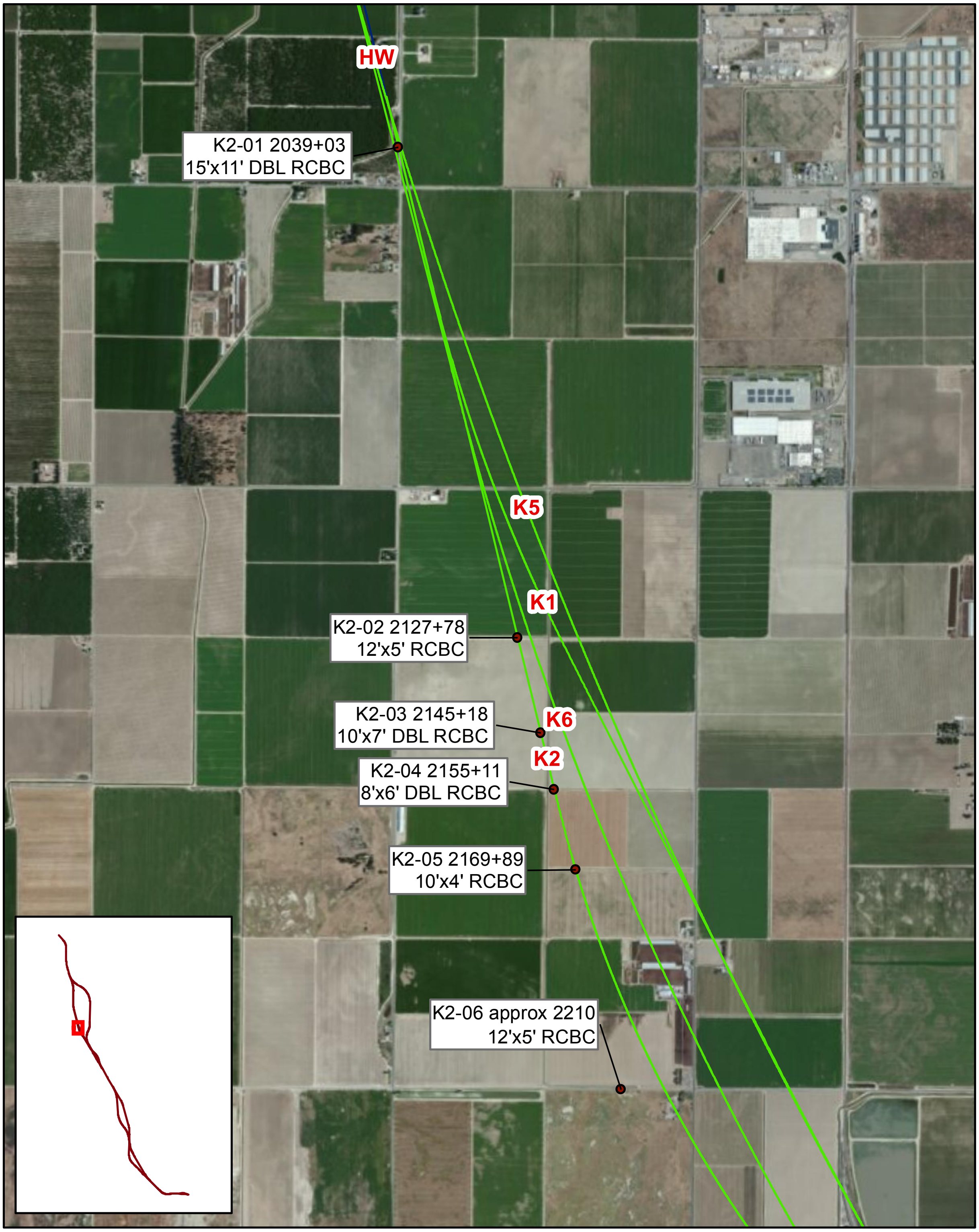
Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-18
Hydraulic Crossing Points

RFP No. HSR 14-32 – INITIAL RELEASE - 05/27/2015



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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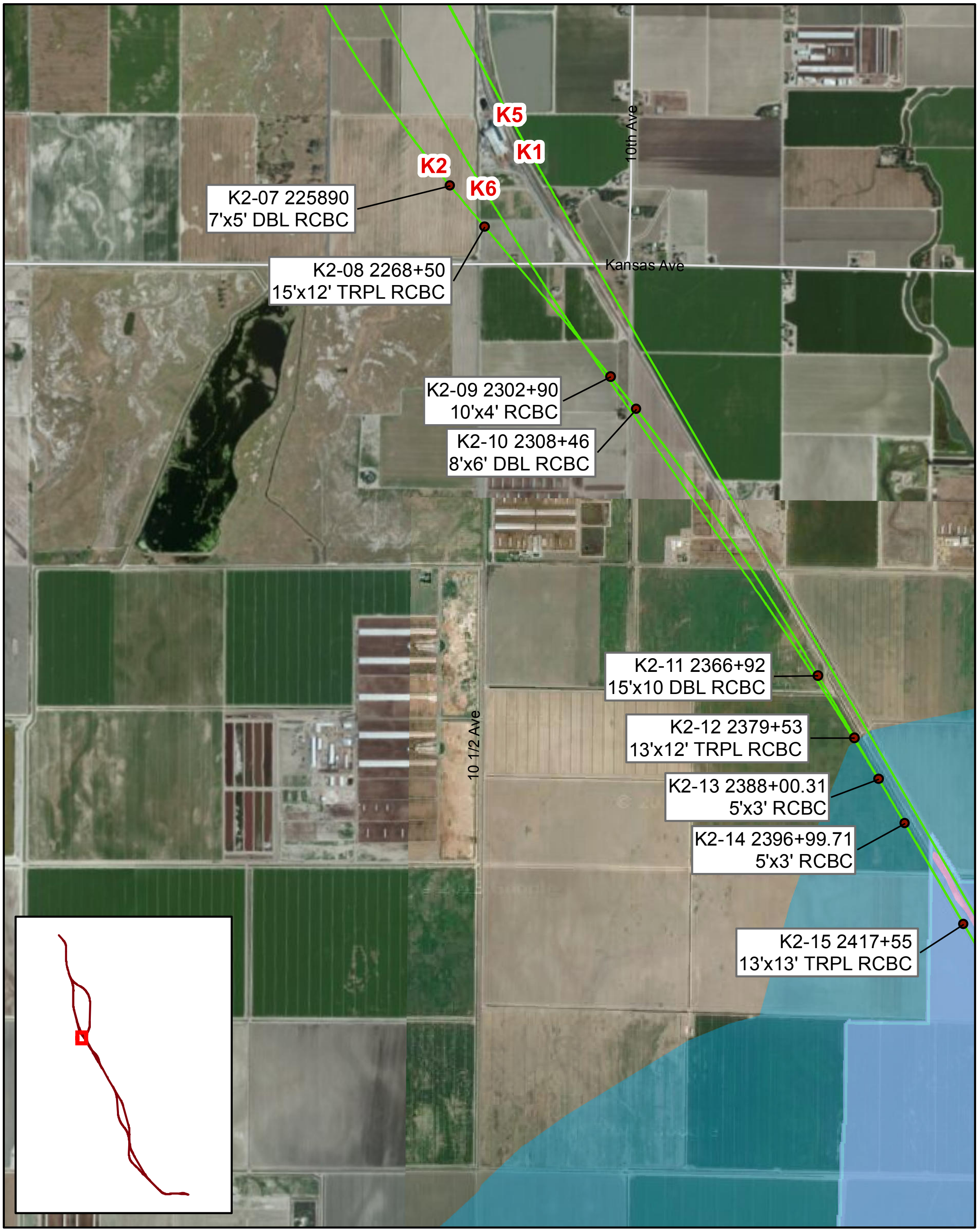
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-19
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013

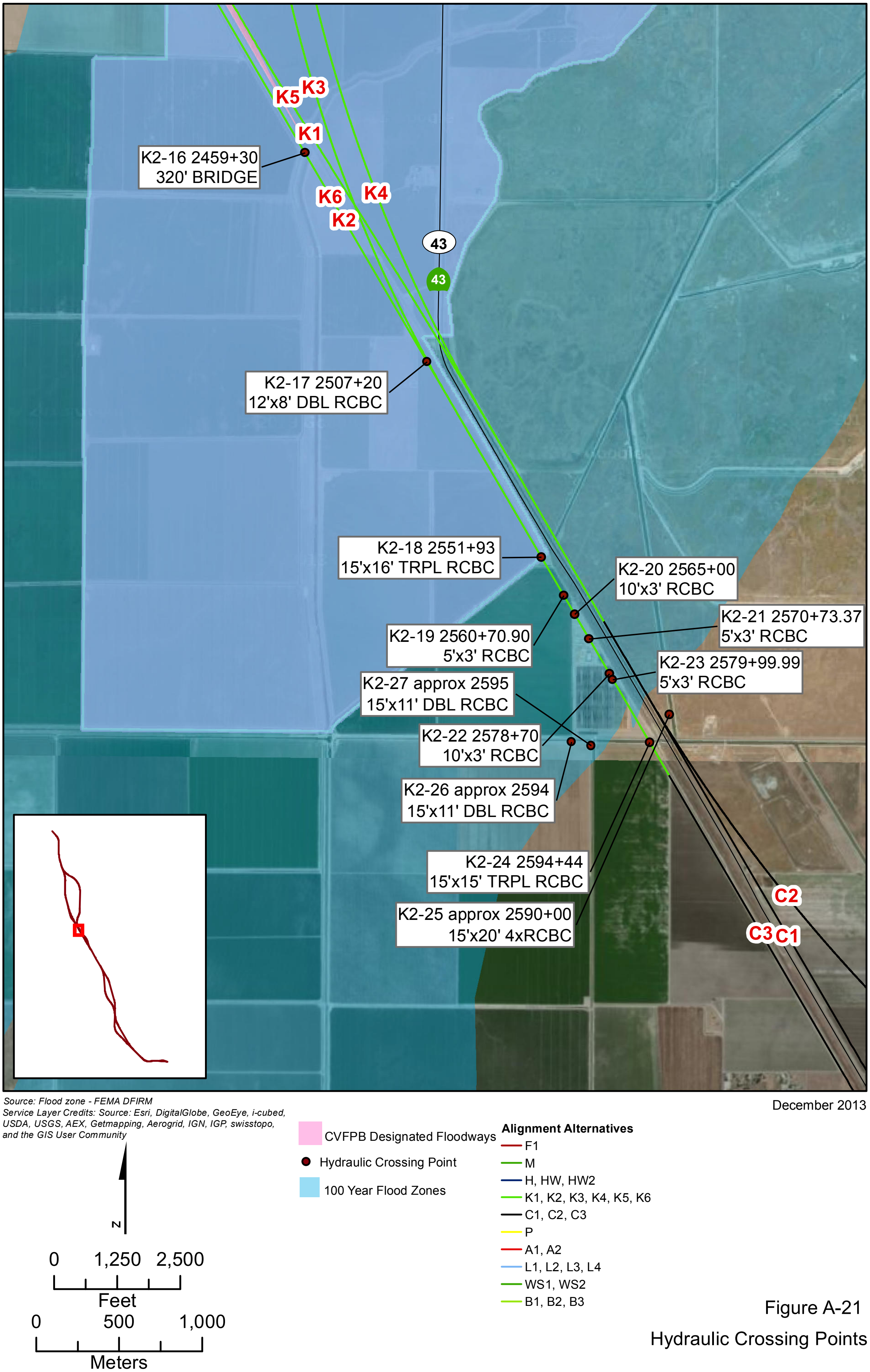
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-20
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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Figure A-21

Hydraulic Crossing Points

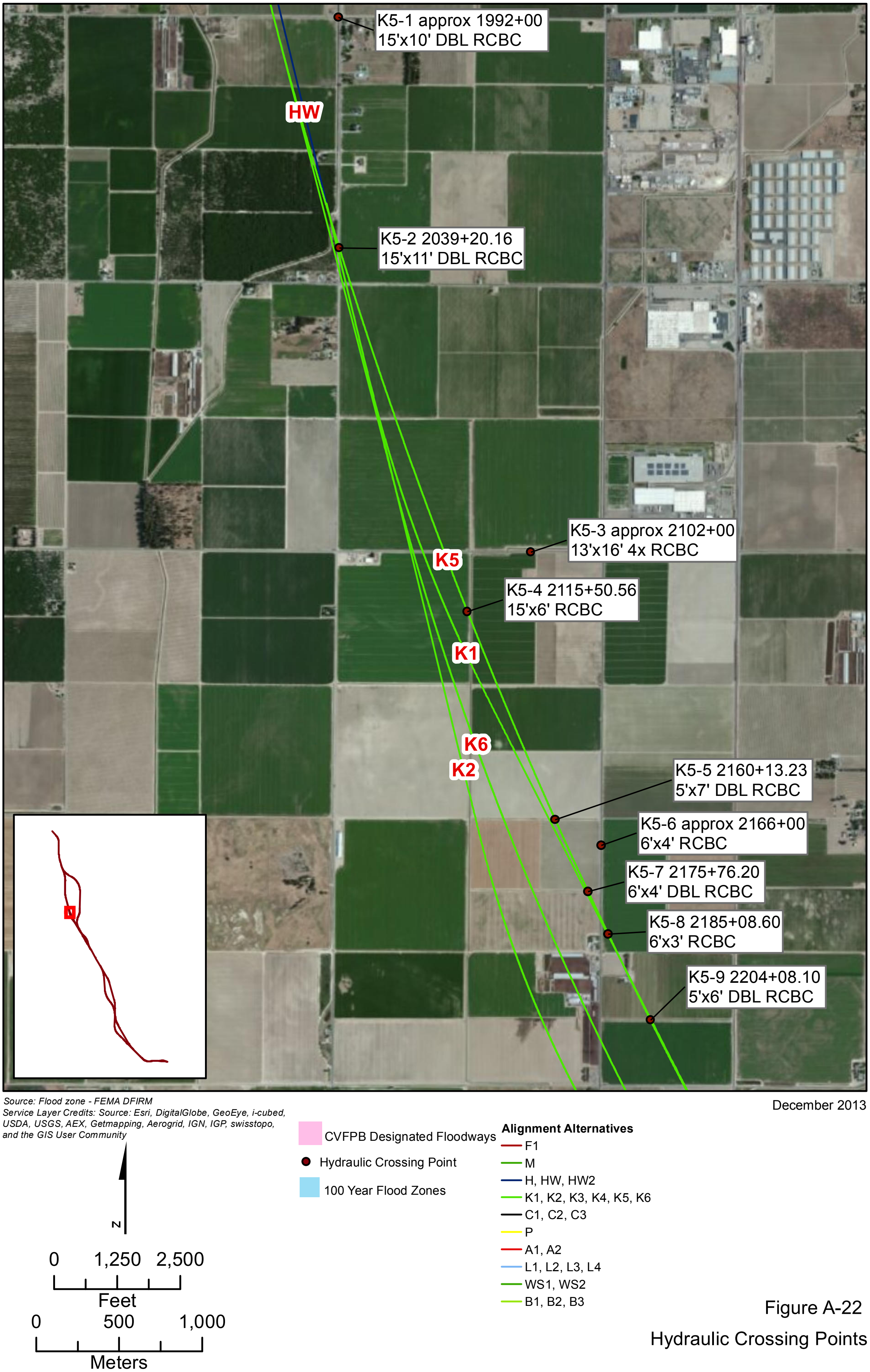

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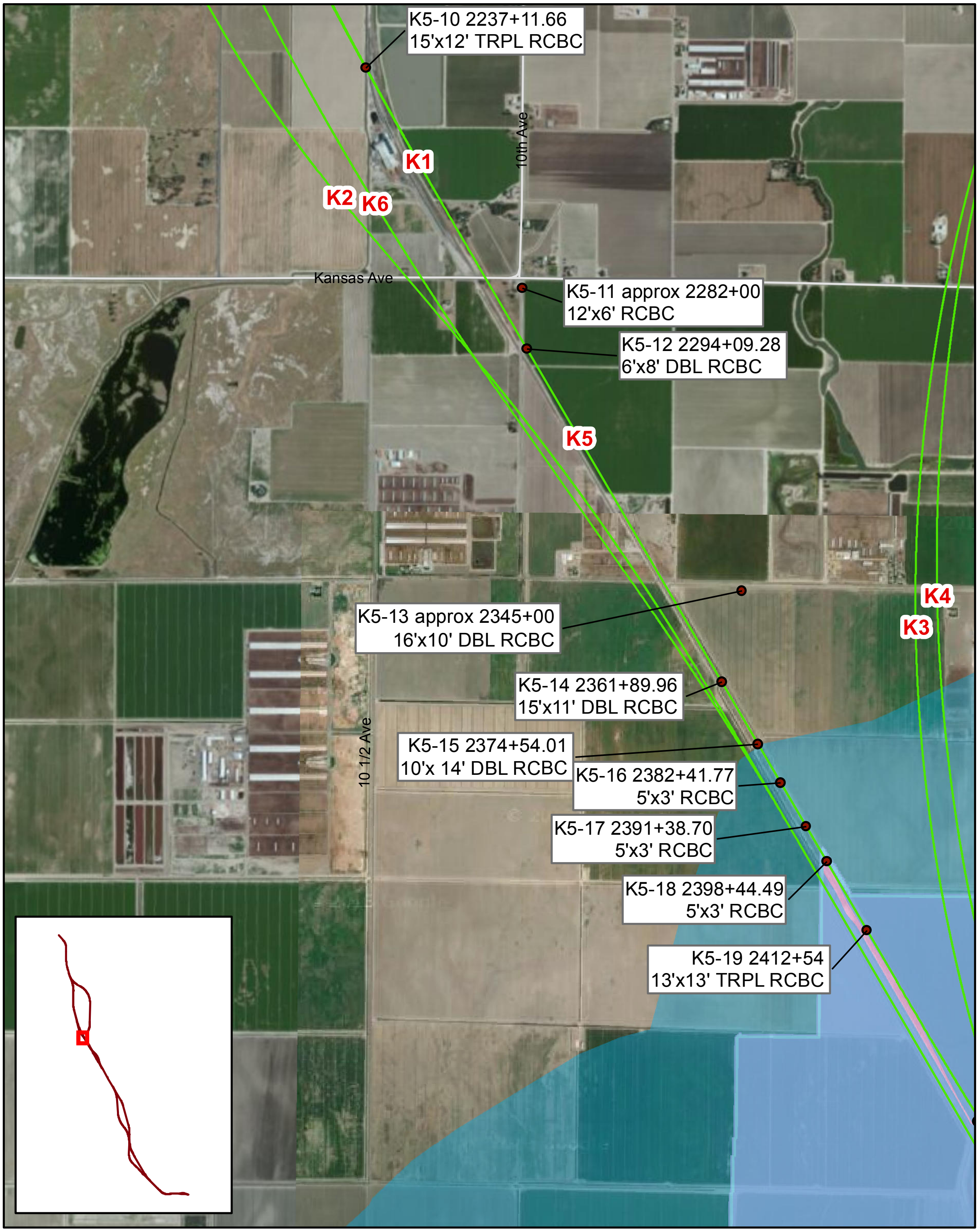
Figure A-22

Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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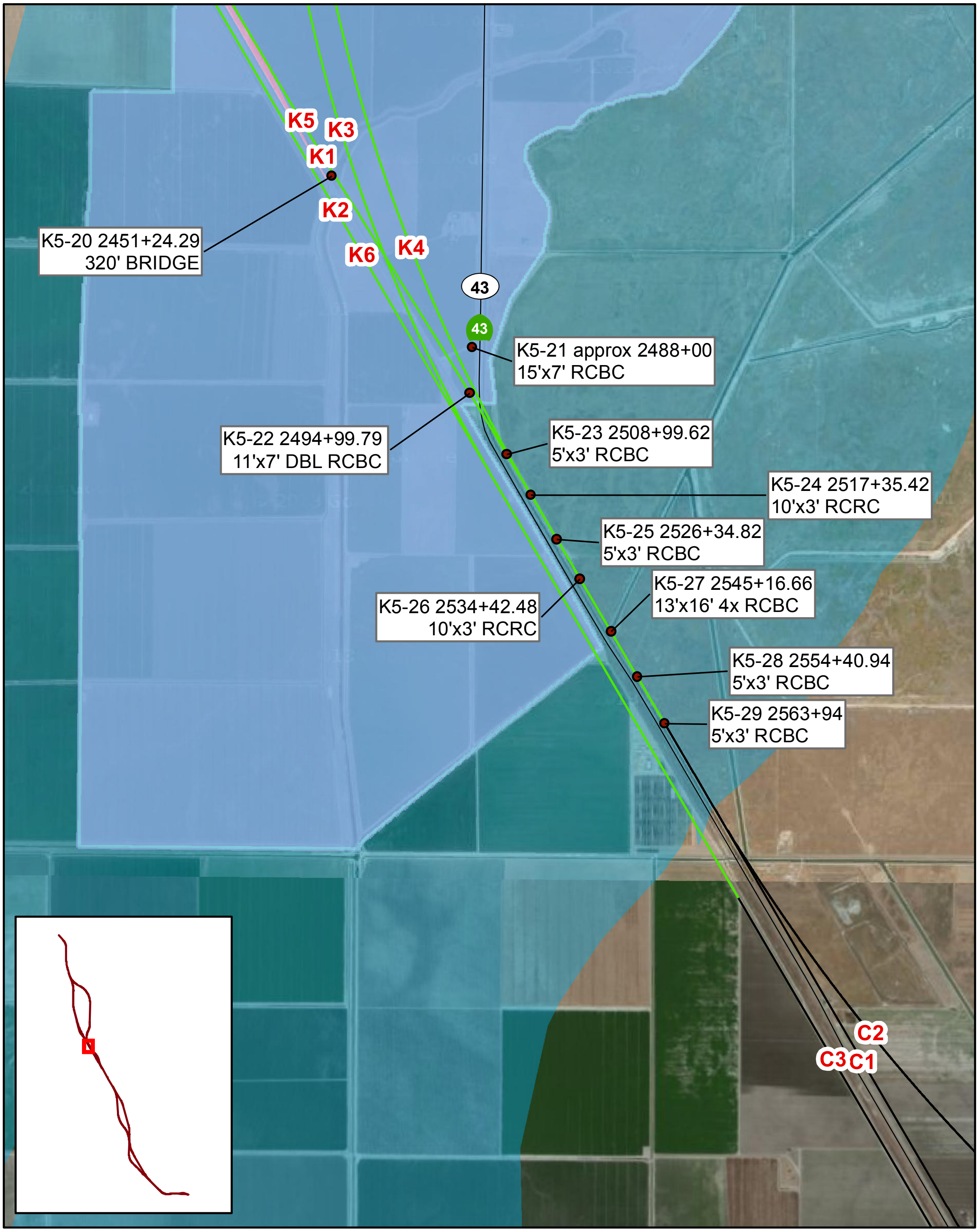
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-23
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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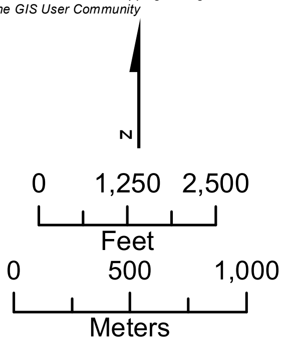
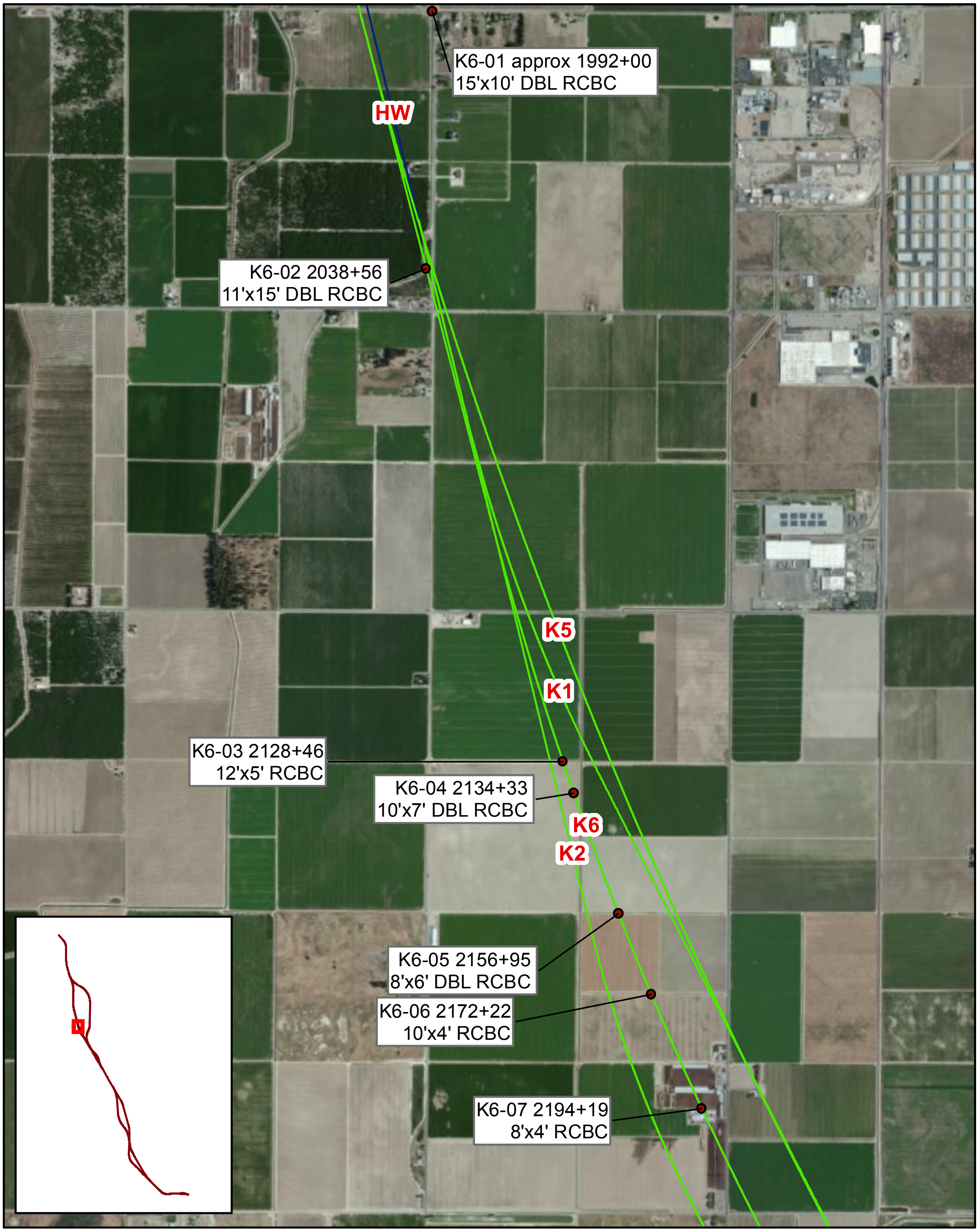


CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

Figure A-24

Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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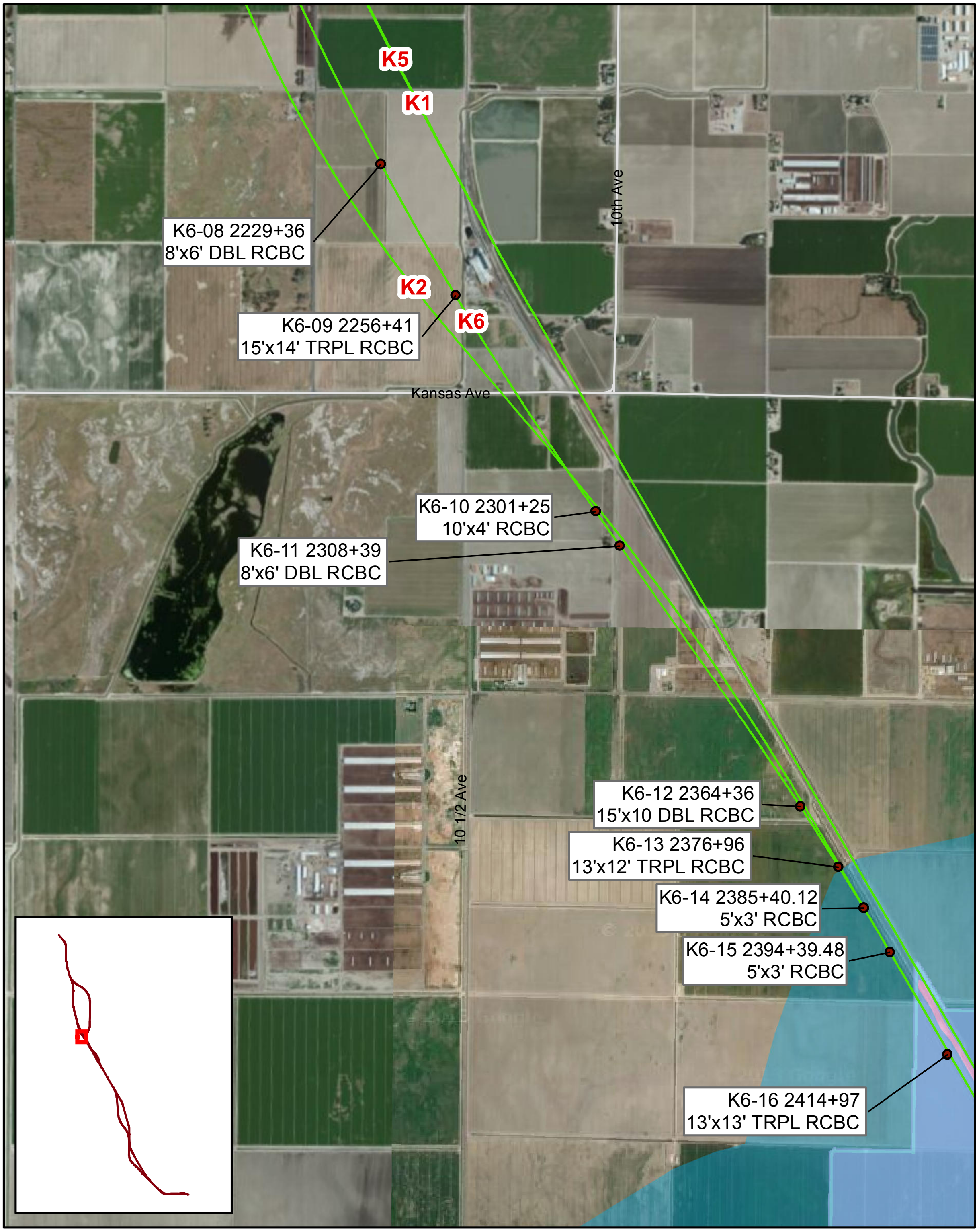
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-25
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-26
Hydraulic Crossing Points

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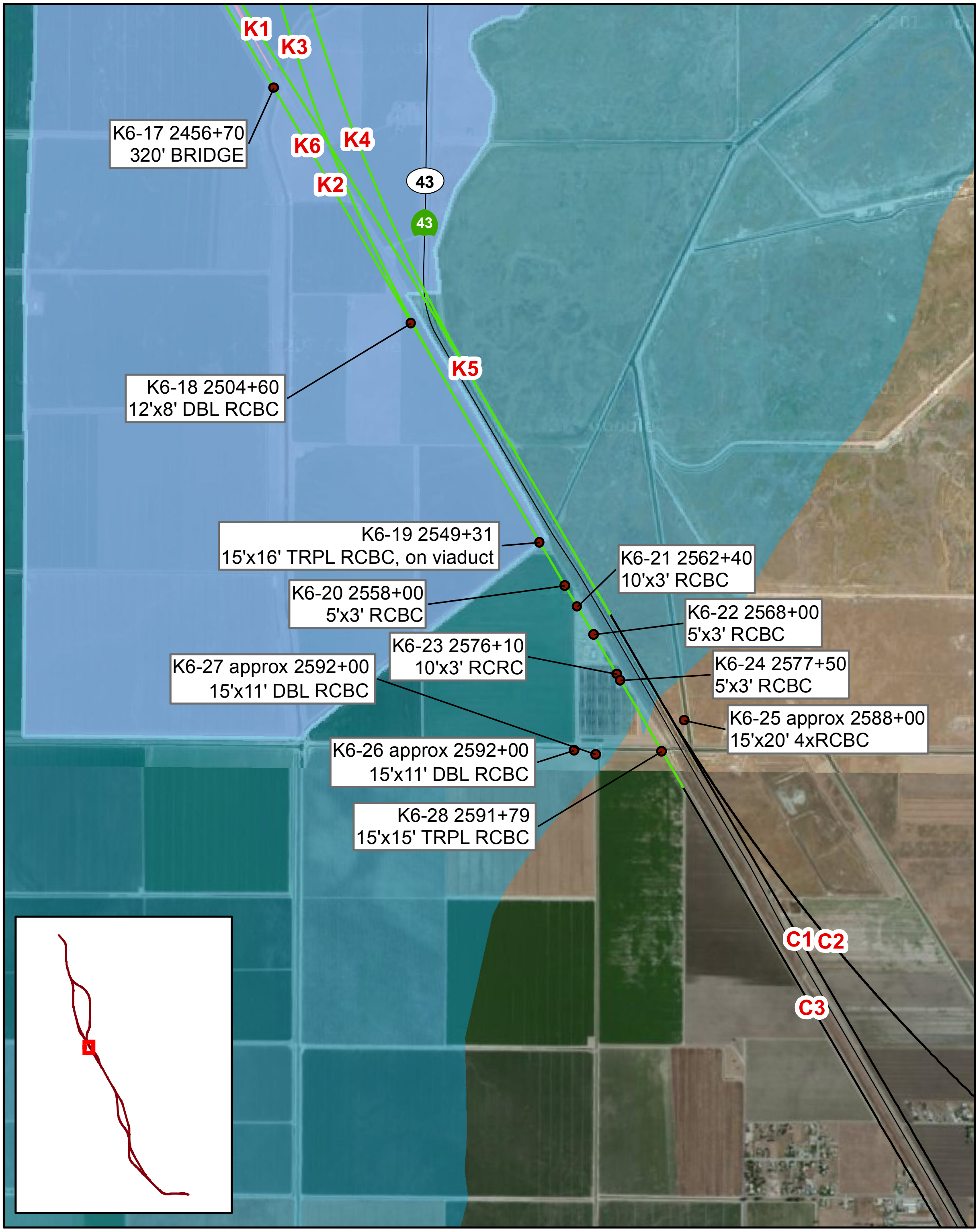

Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

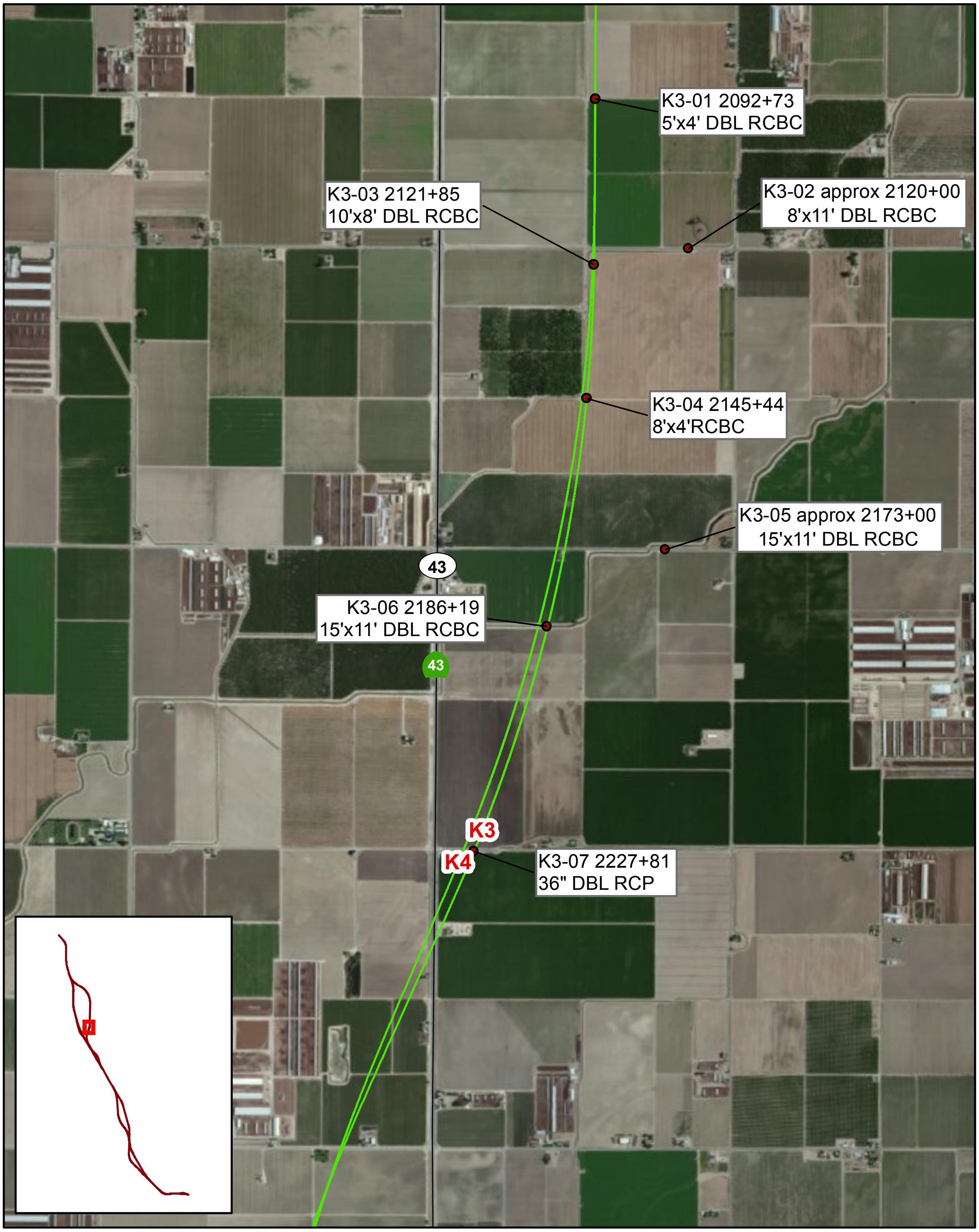
Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-27
Hydraulic Crossing Points

RFP No. HSR 14-32 – INITIAL RELEASE - 05/27/2015



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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CVFPB Designated Floodways

Hydraulic Crossing Point

100 Year Flood Zones

Alignment Alternatives

- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

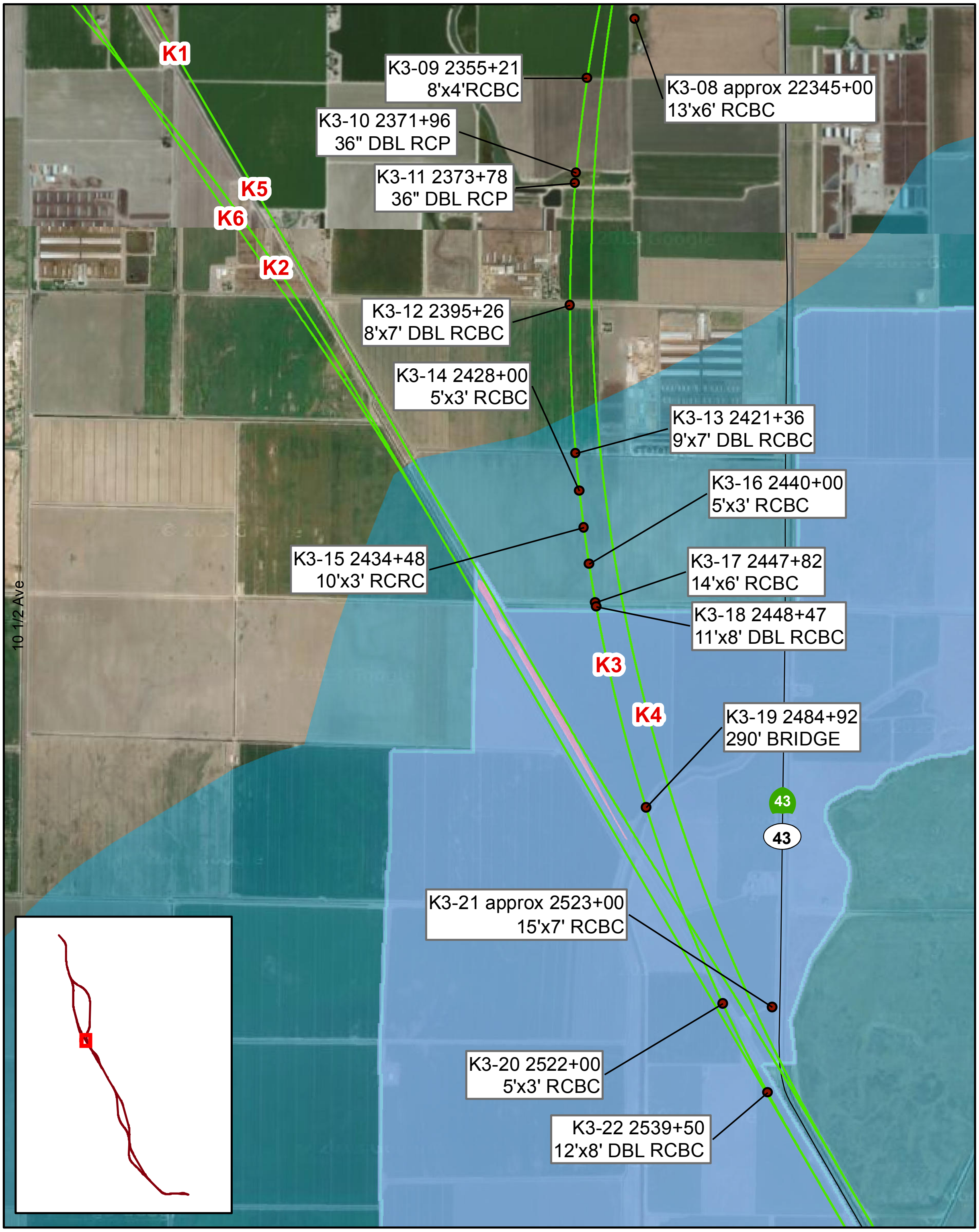
N

0 1,250 2,500
Feet

0 500 1,000
Meters

Figure A-28

Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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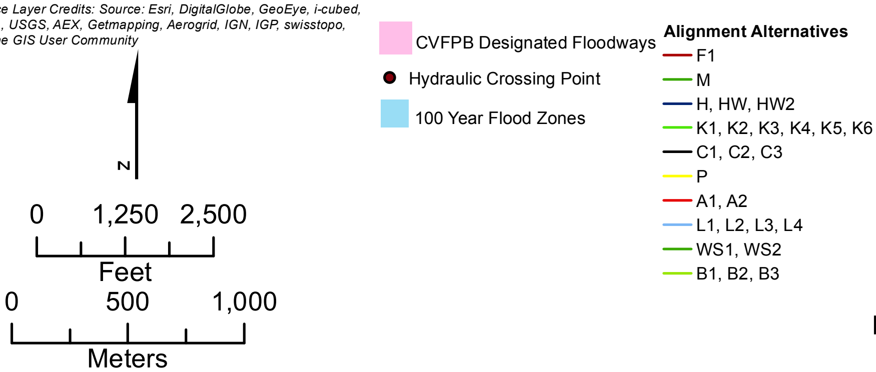
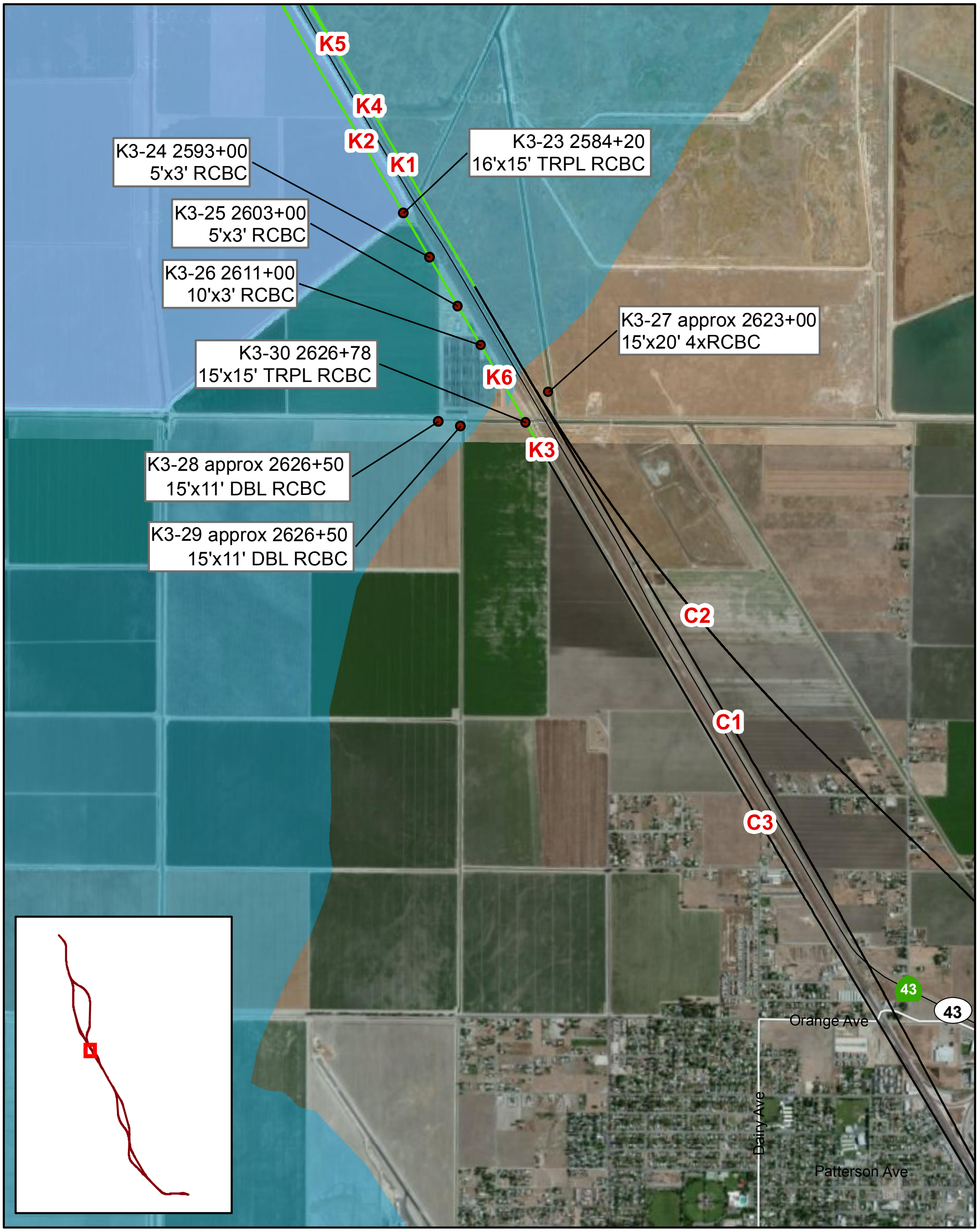


Figure A-29

Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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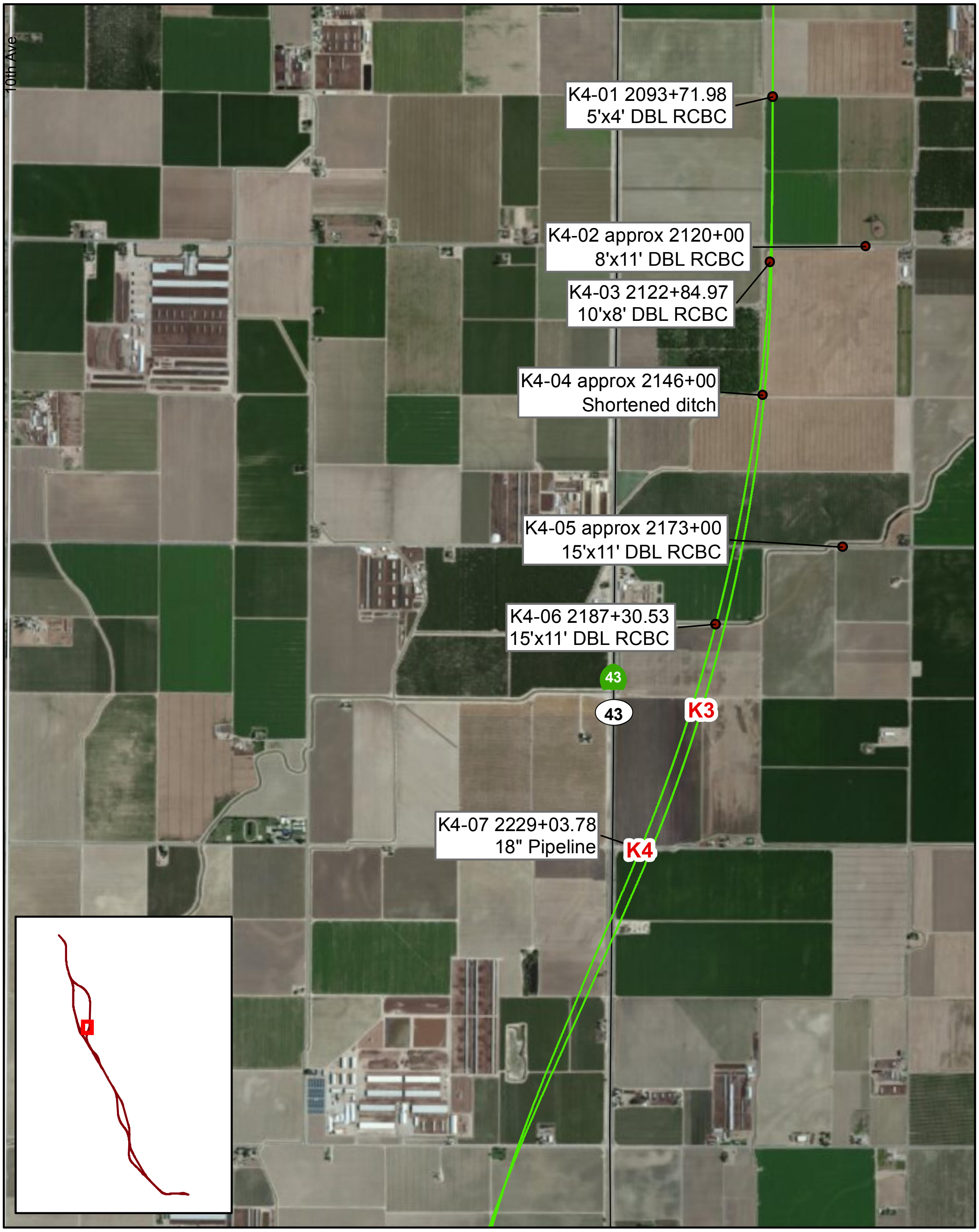
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-30
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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CVFPB Designated Floodways

Hydraulic Crossing Point

100 Year Flood Zones

Alignment Alternatives

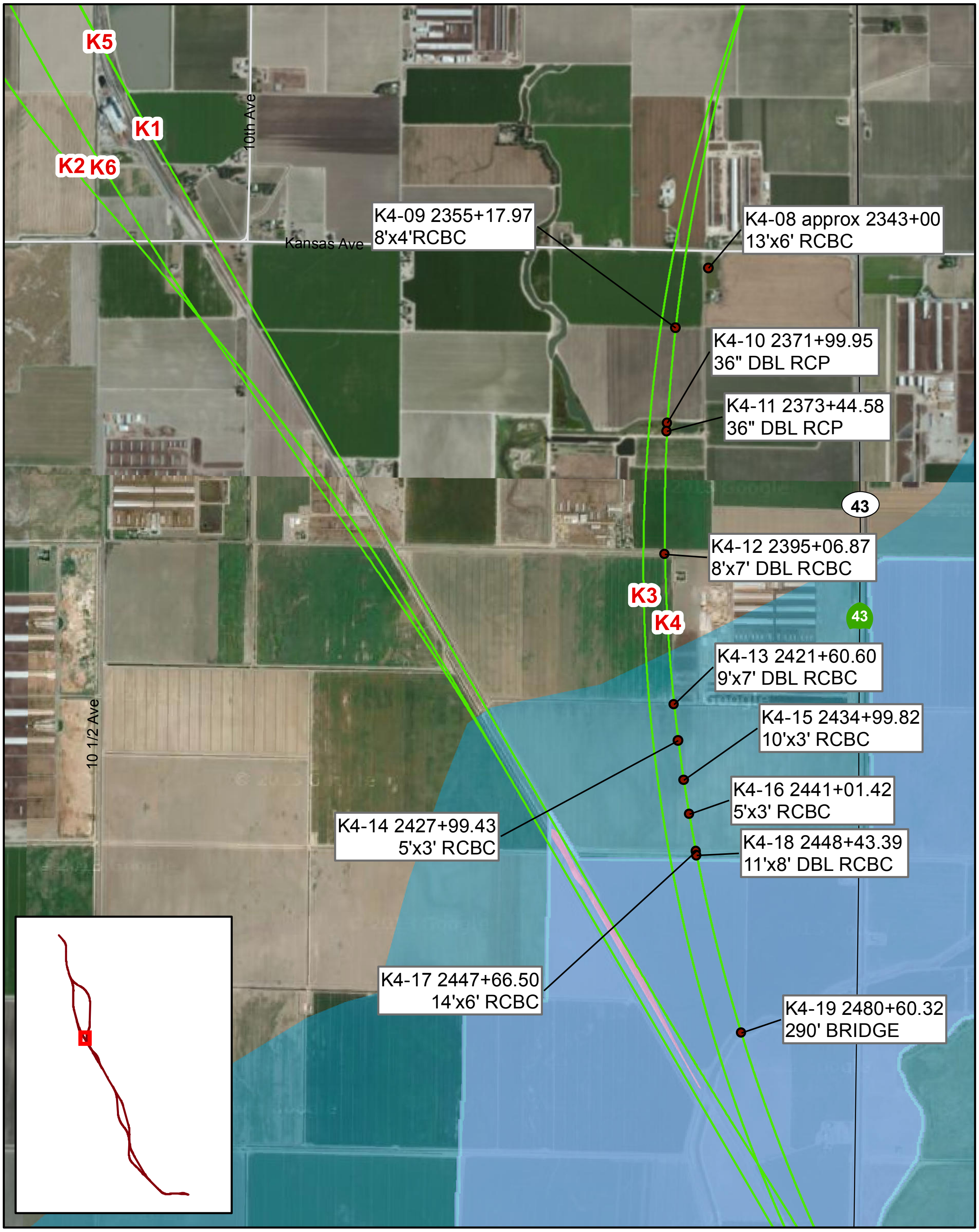
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet

0 500 1,000
Meters

Figure A-31
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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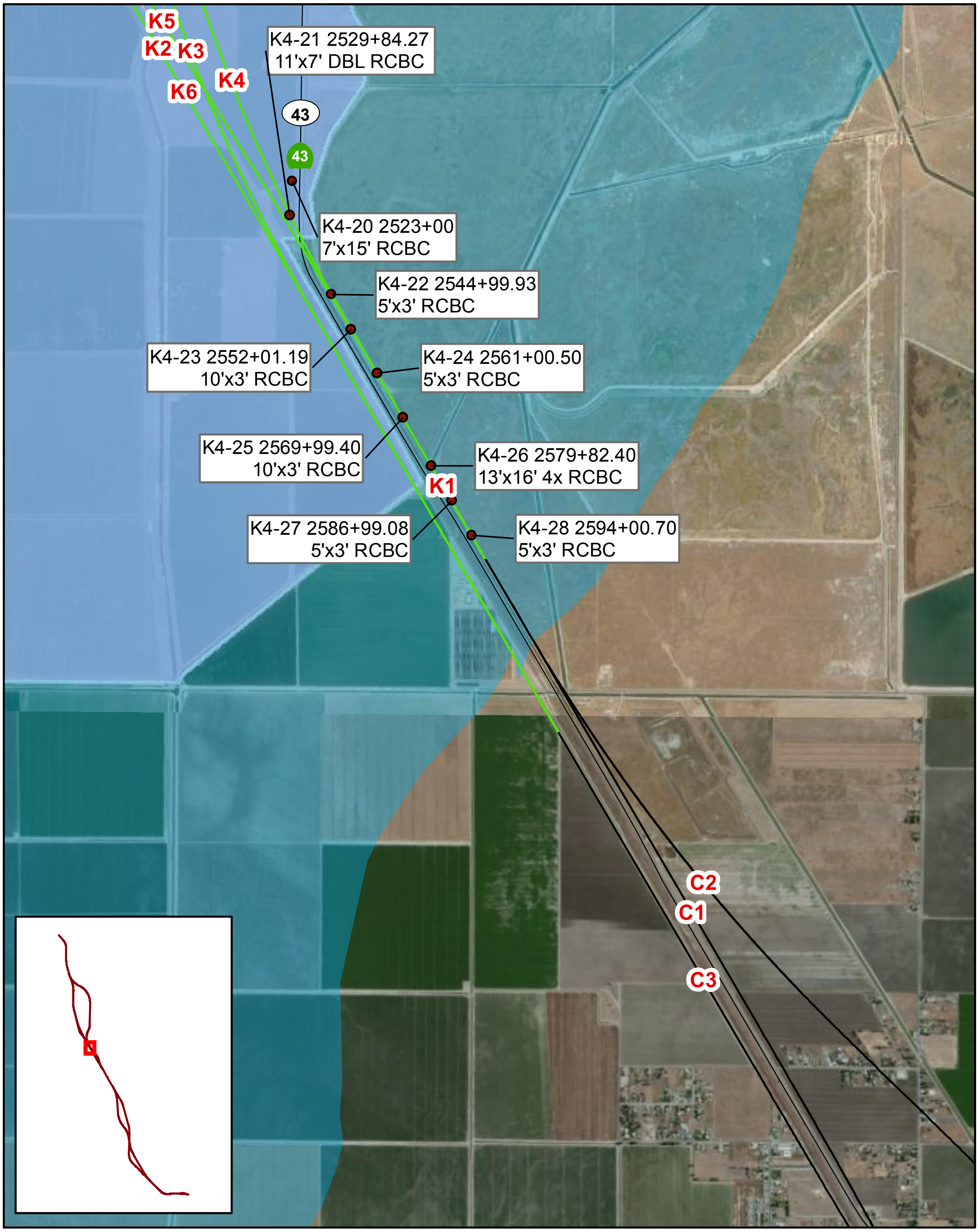
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-32
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

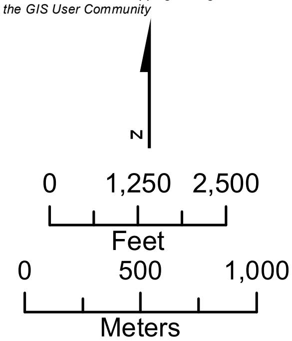
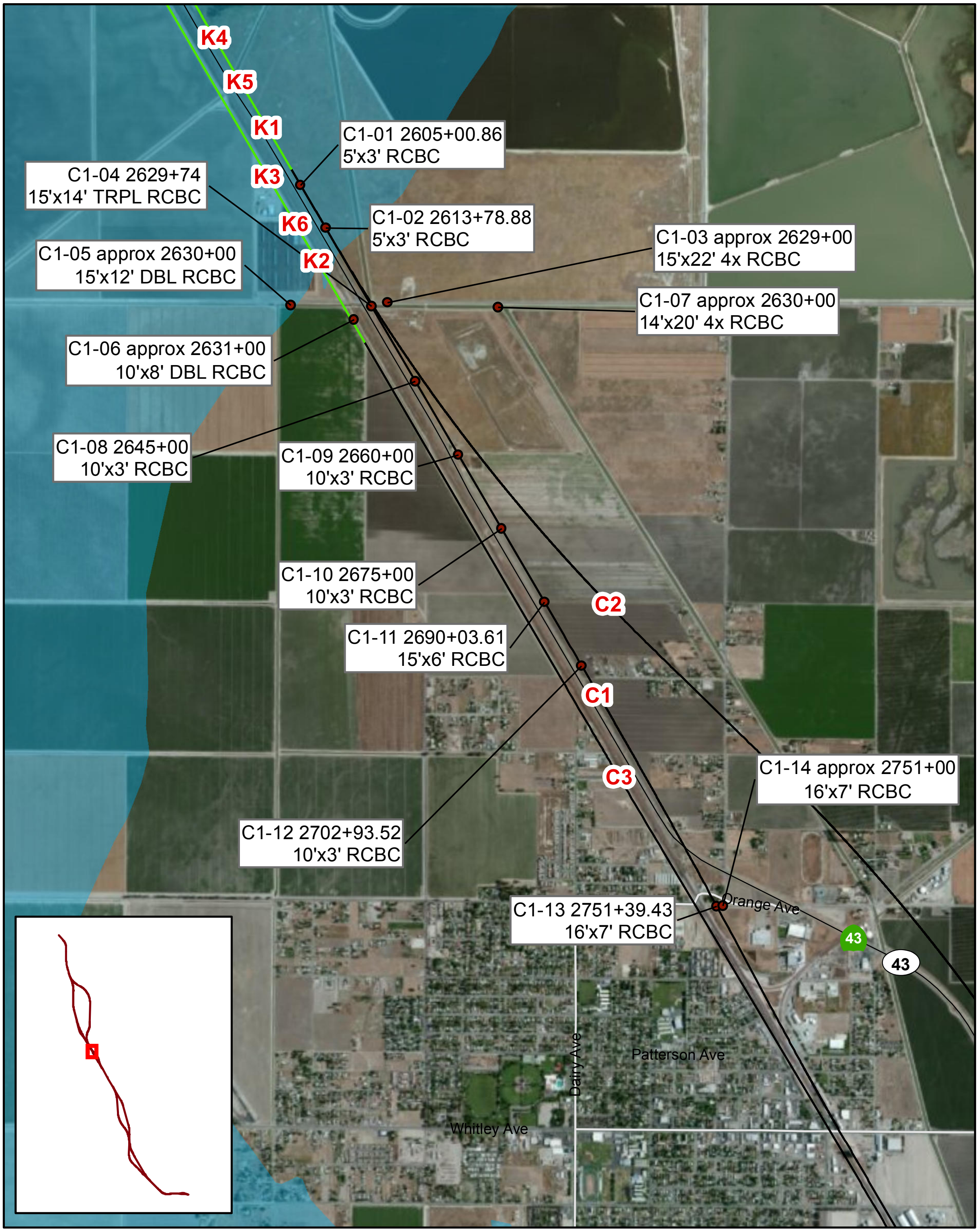


Figure A-33
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013

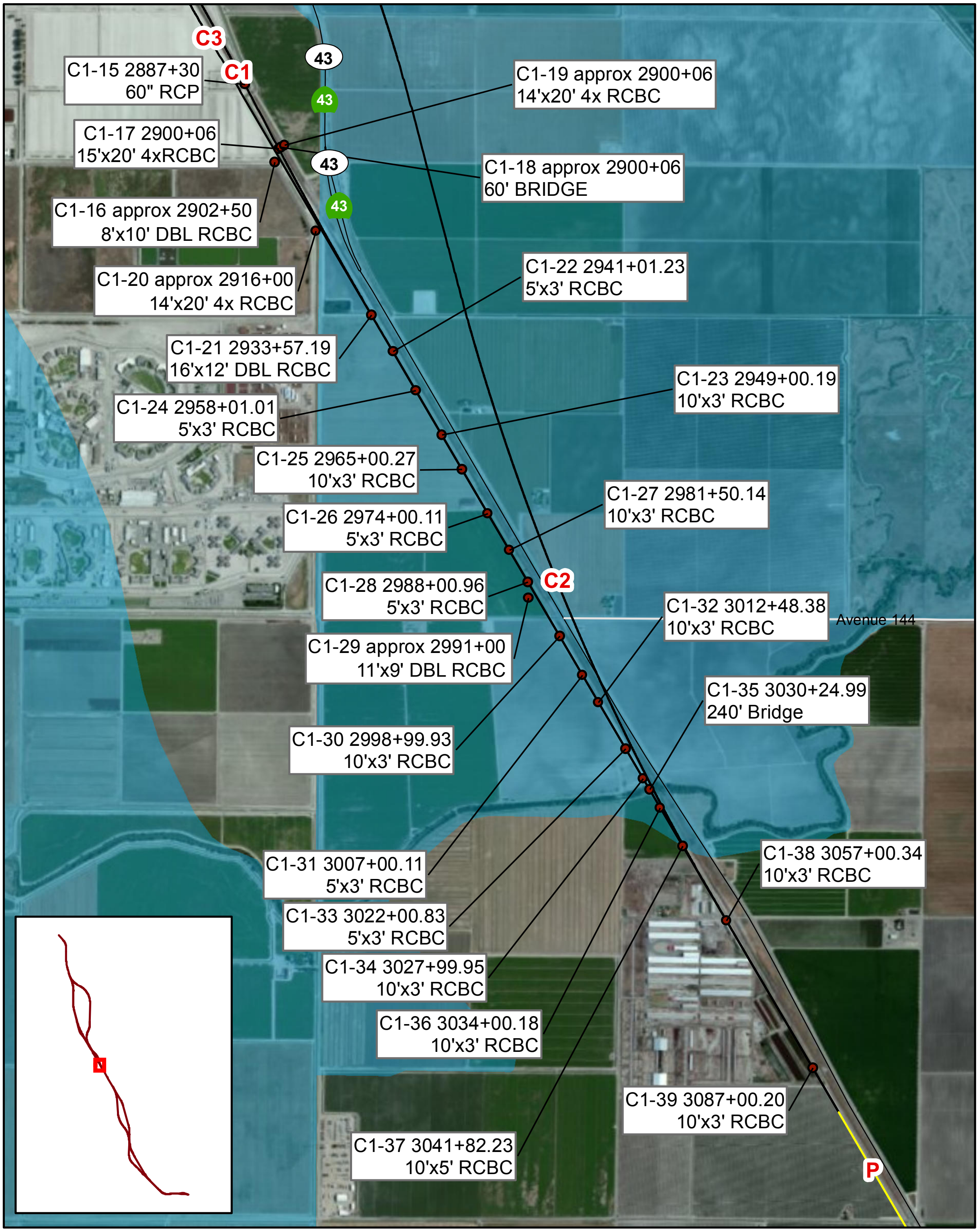
N

0 1,250 2,500
Feet
0 500 1,000
Meters

CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

Figure A-34
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-35
Hydraulic Crossing Points

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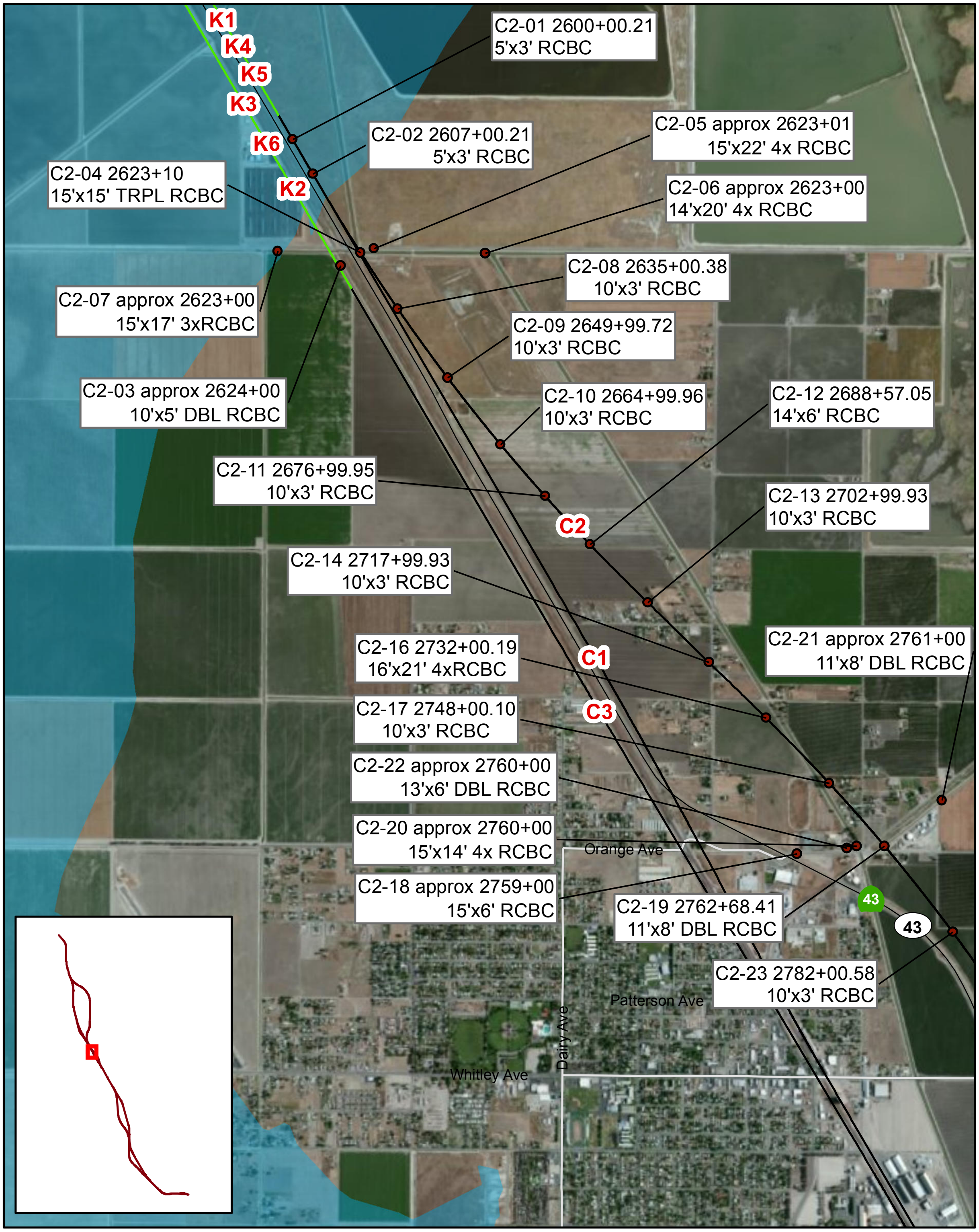


Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013

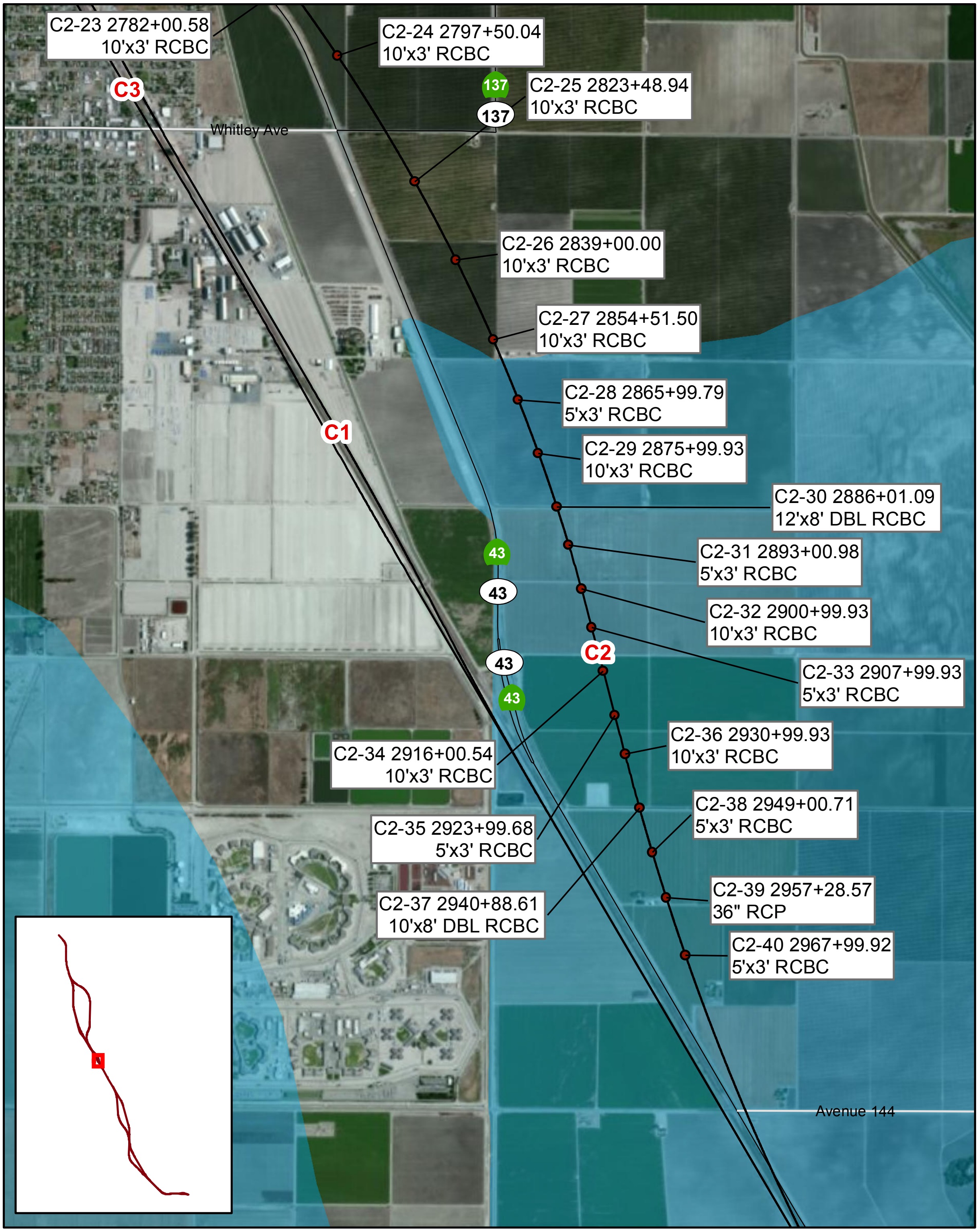
N

0 1,250 2,500
Feet
0 500 1,000
Meters

CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

Figure A-36
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

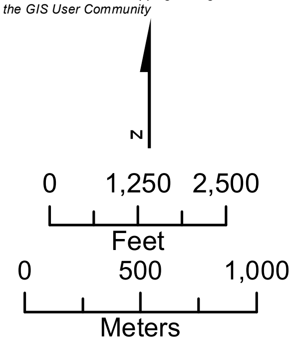
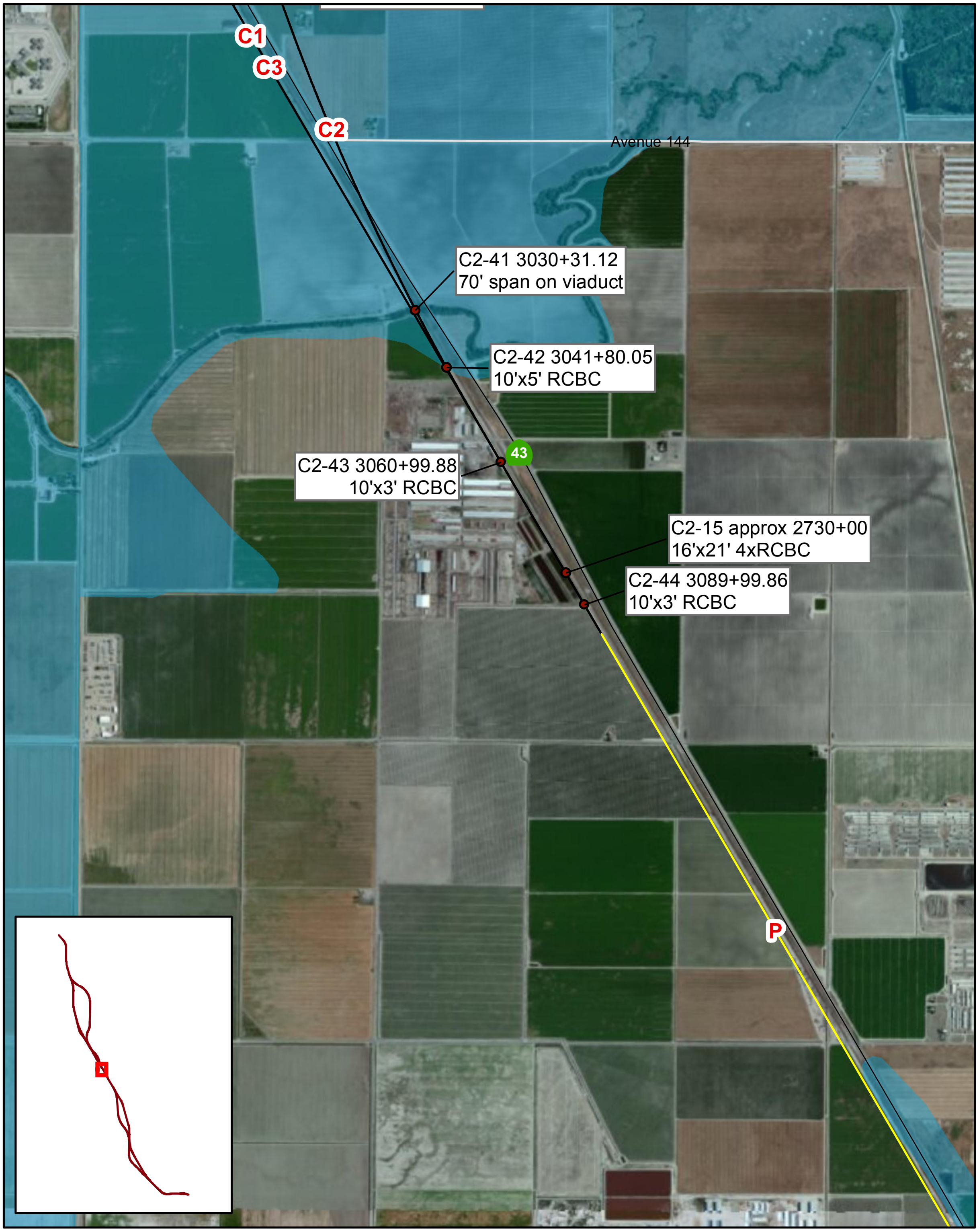


Figure A-37
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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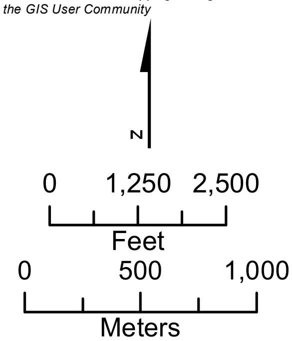
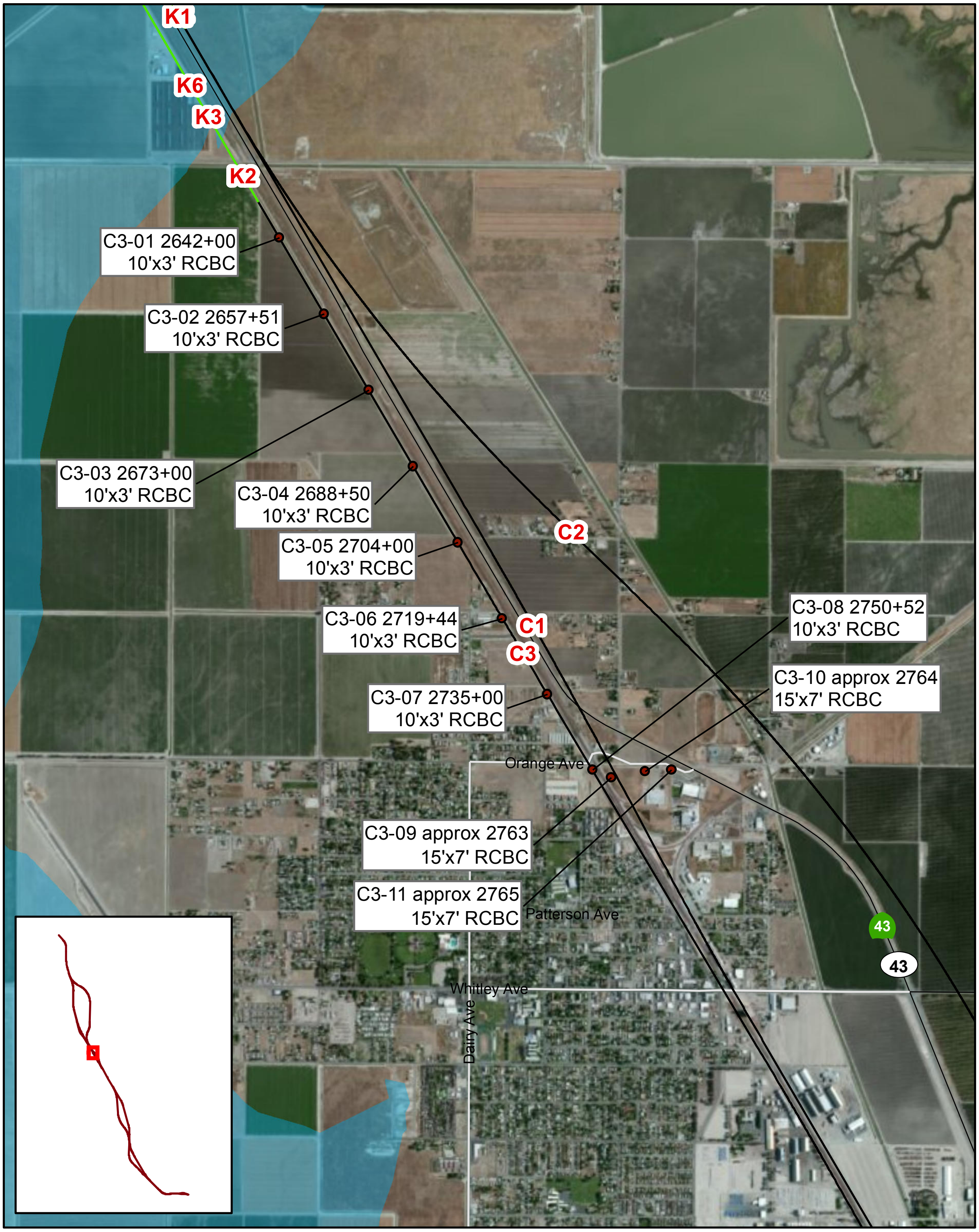


CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

Figure A-38

Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013

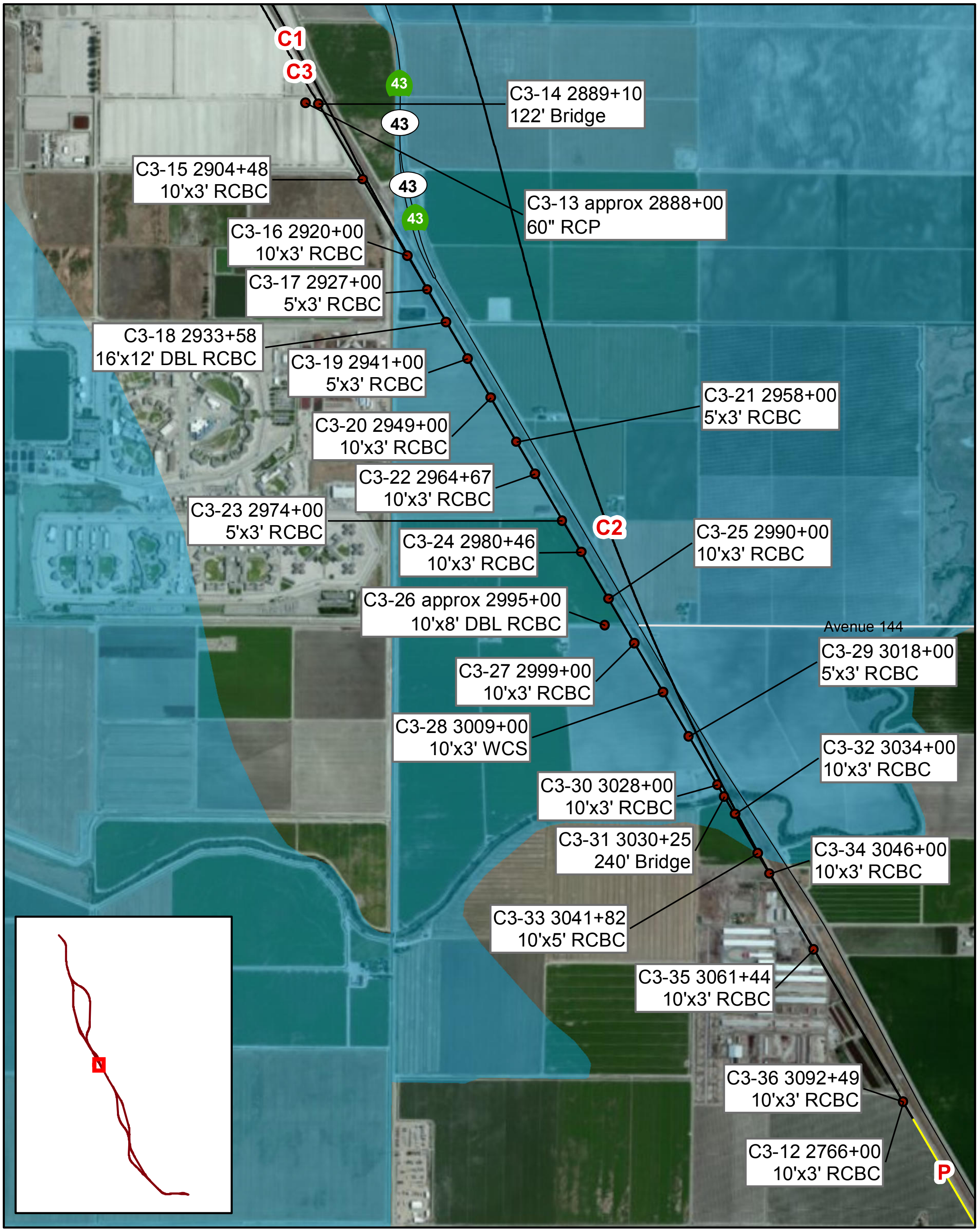
N

0 1,250 2,500
Feet
0 500 1,000
Meters

CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

Figure A-39
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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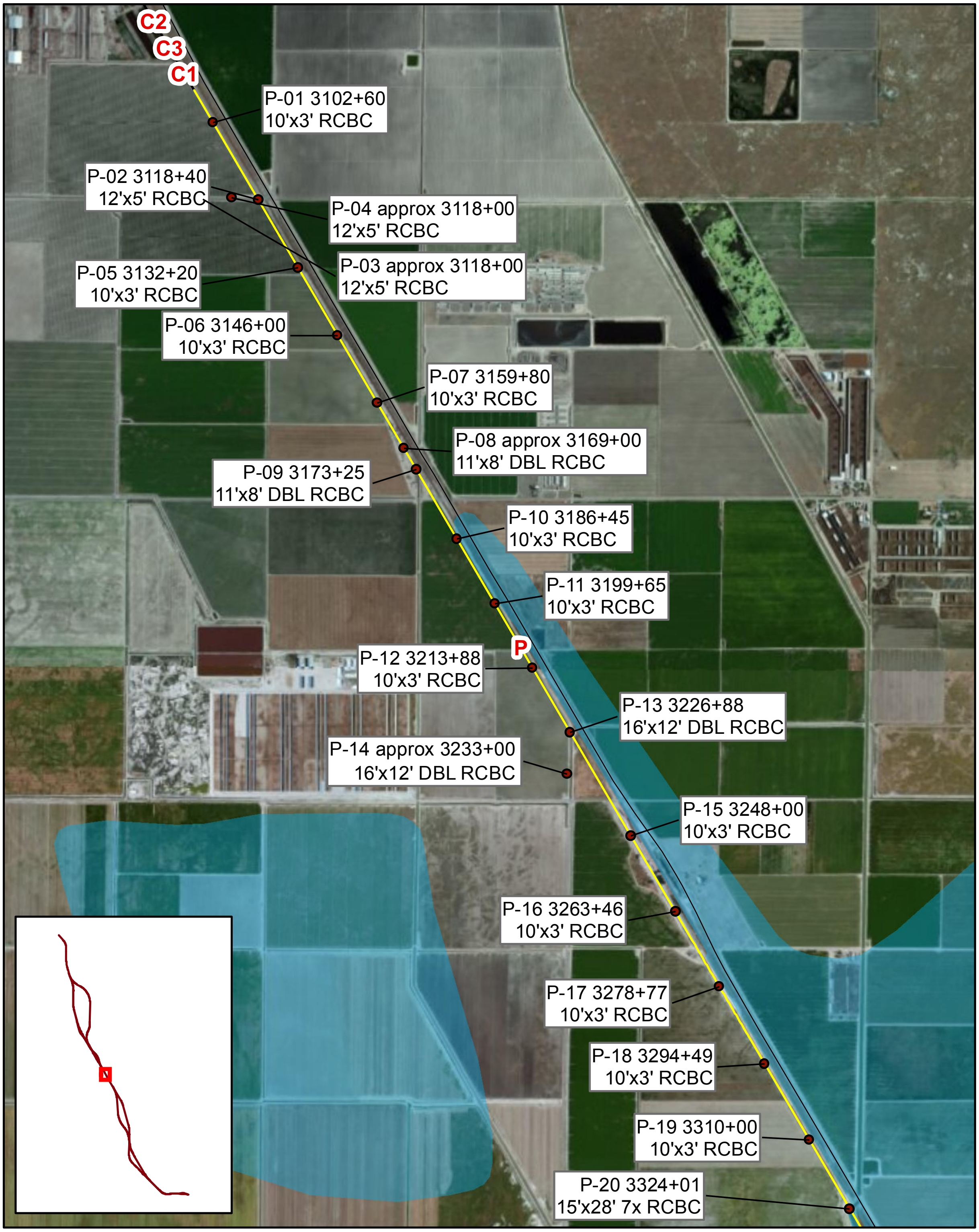
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-40
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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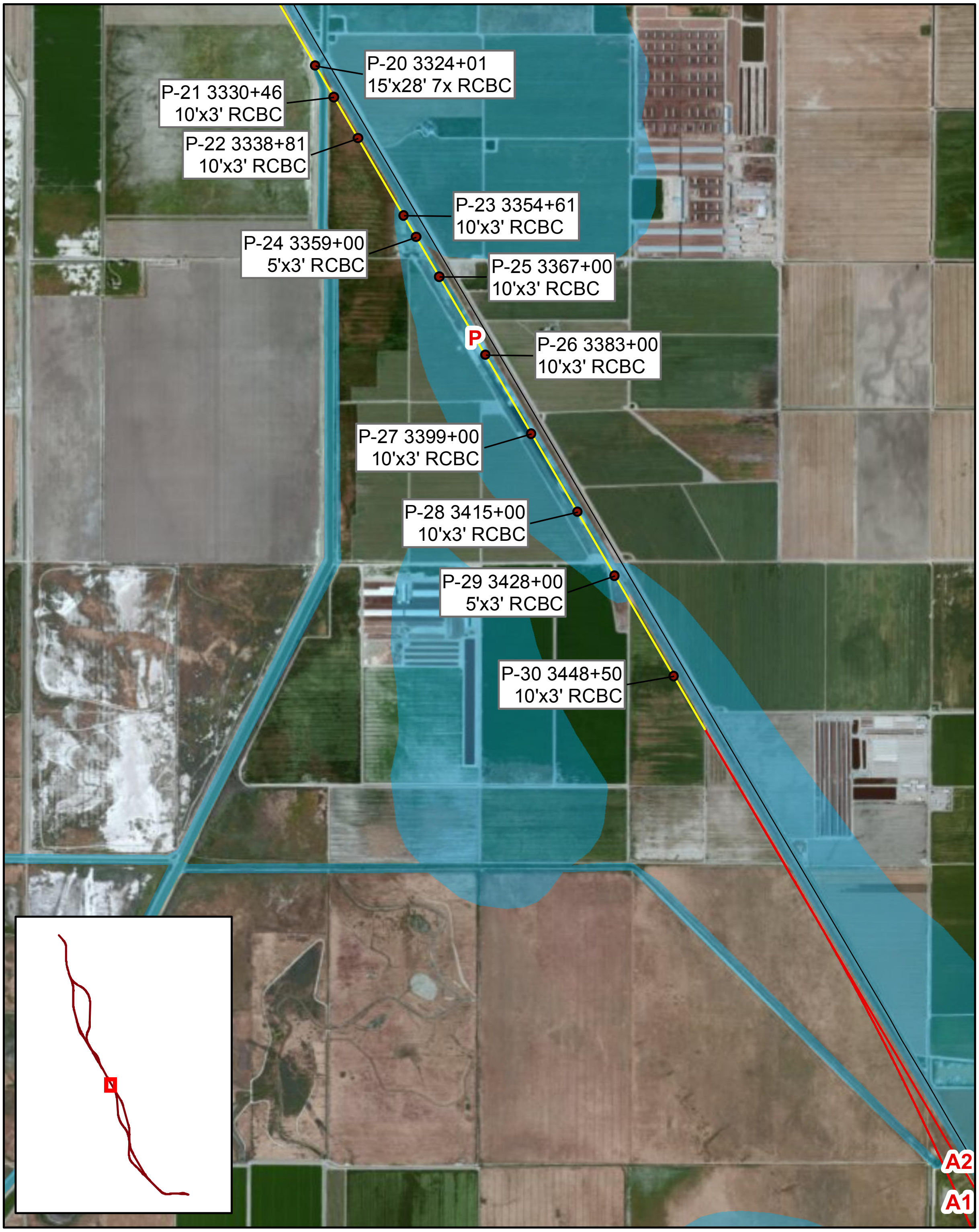
CVFPB Designated Floodways
Hydraulic Crossing Point
Hydraulic Crossings - P
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-41
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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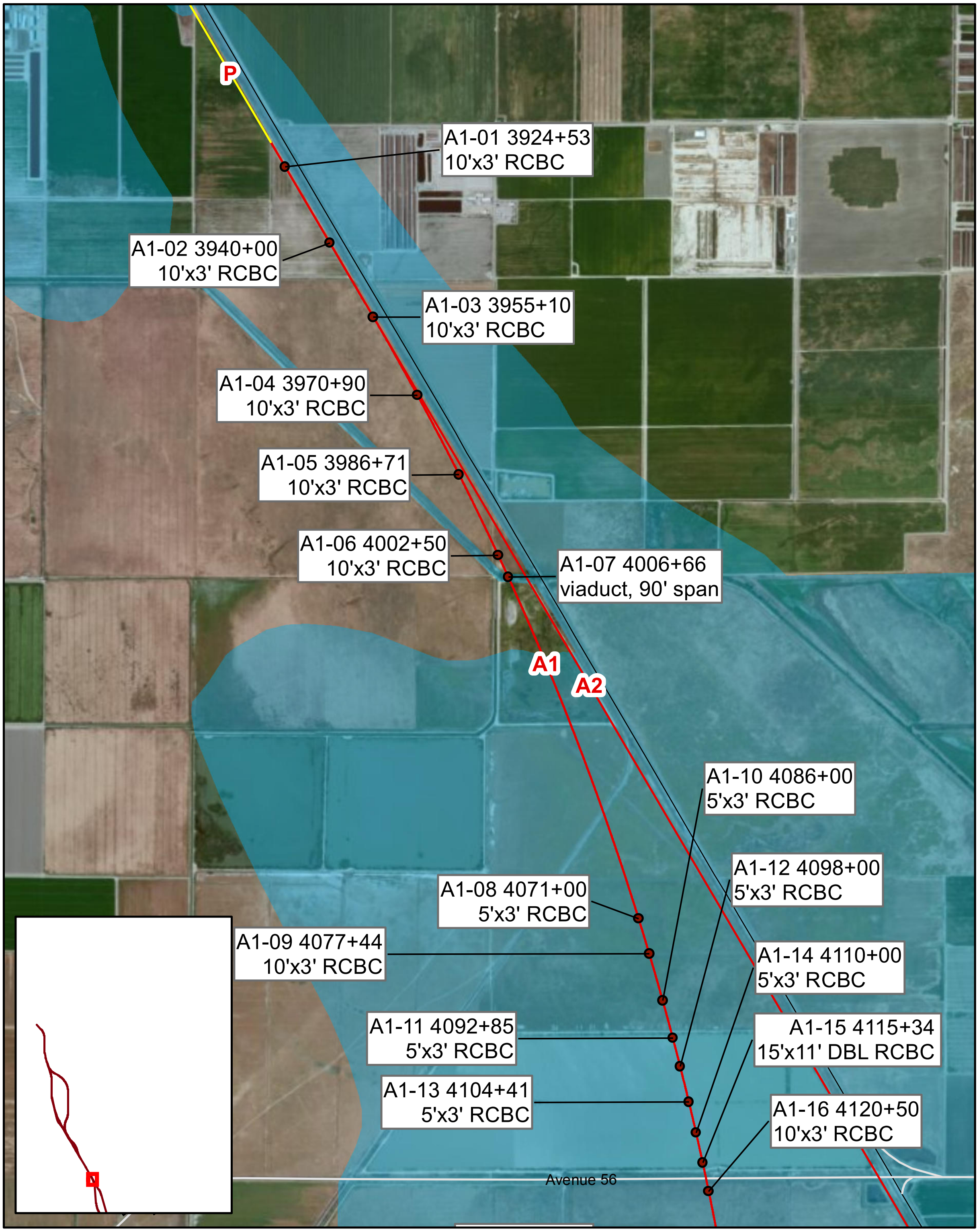
CVFPB Designated Floodways
Hydraulic Crossing Point
Hydraulic Crossings - P
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-42
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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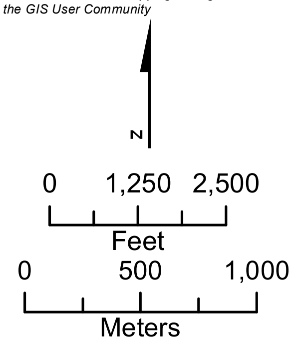
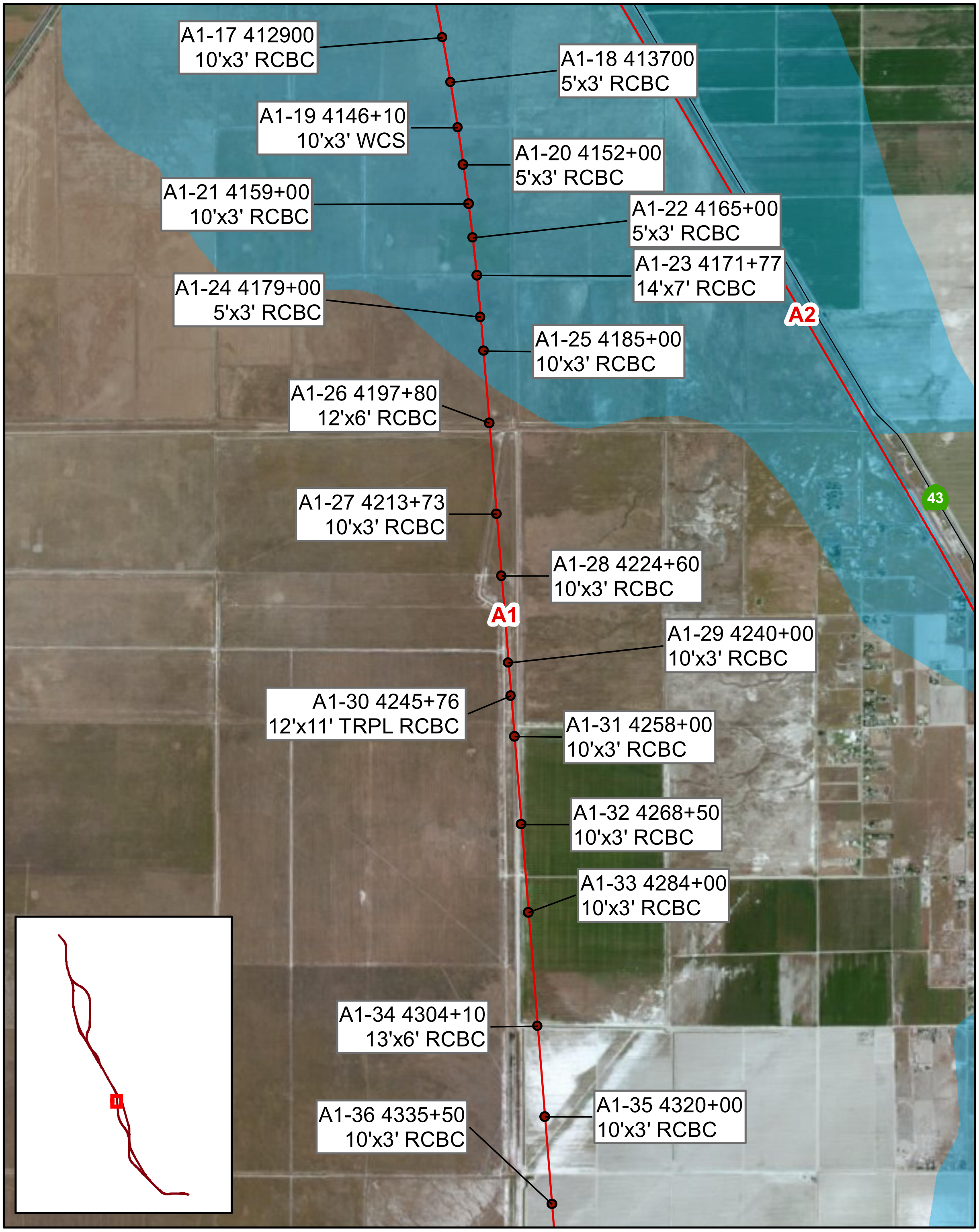


- CVFPB Designated Floodways
- Hydraulic Crossing Point
- 100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

Figure A-43
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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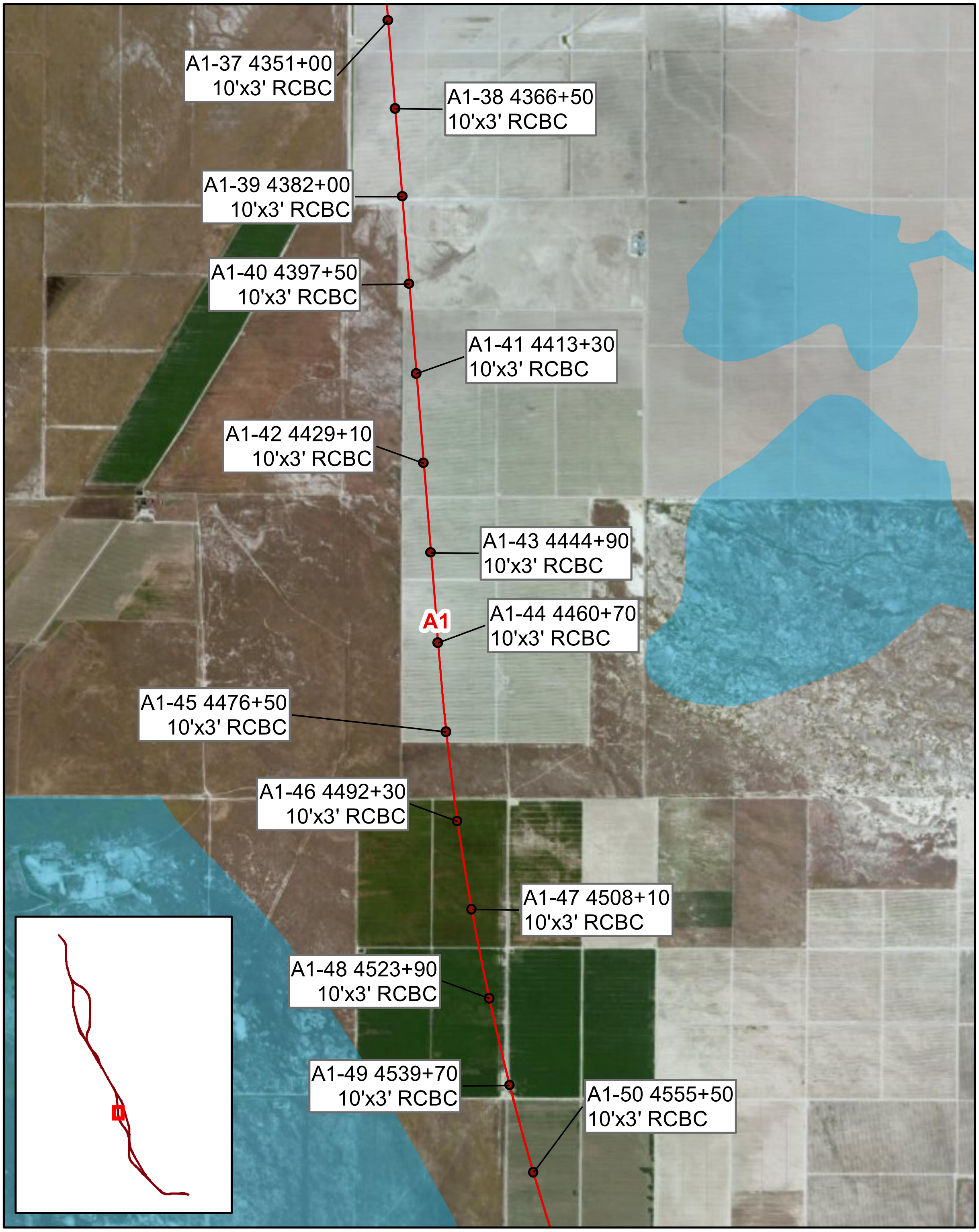
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-44
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-45
Hydraulic Crossing Points

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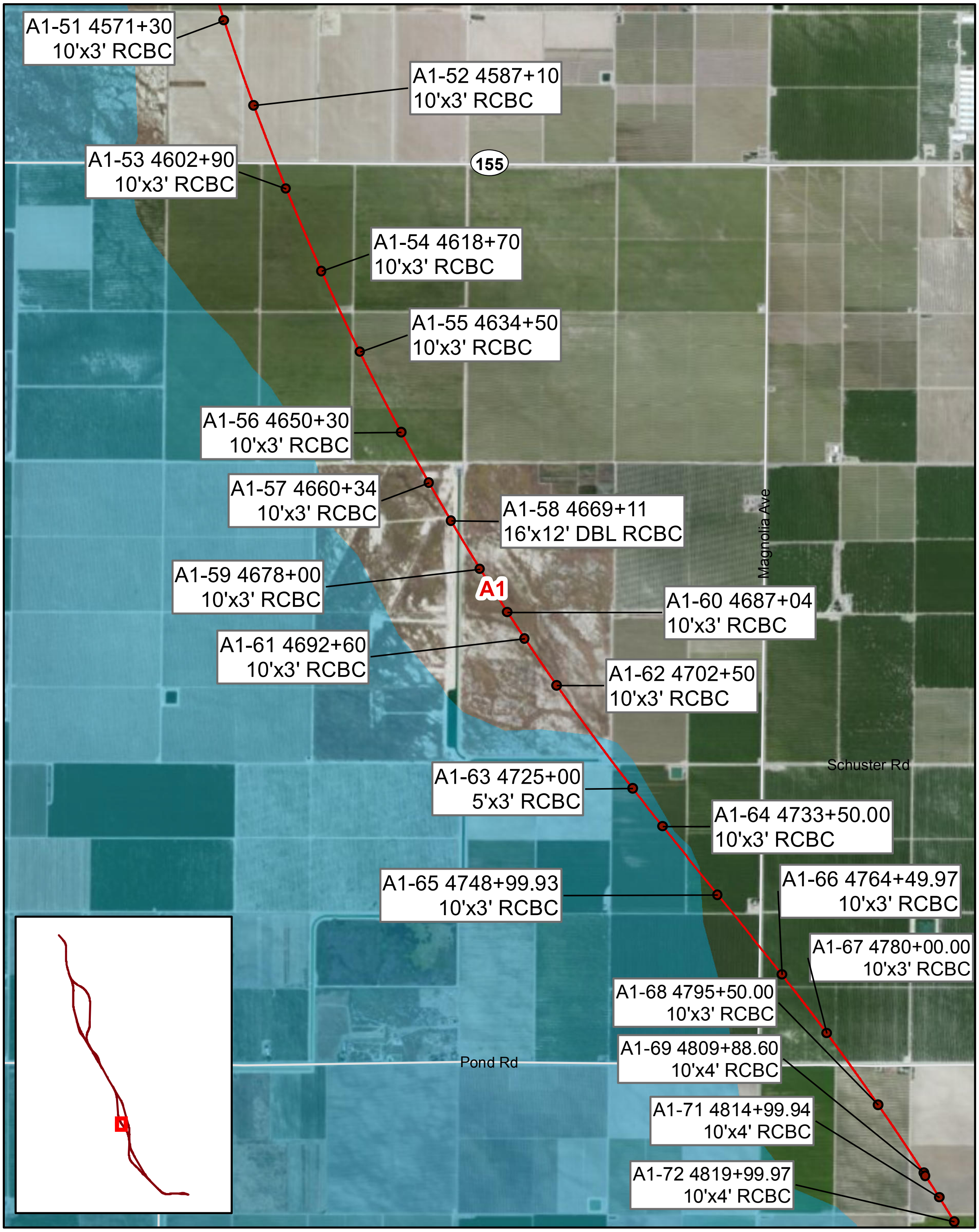

Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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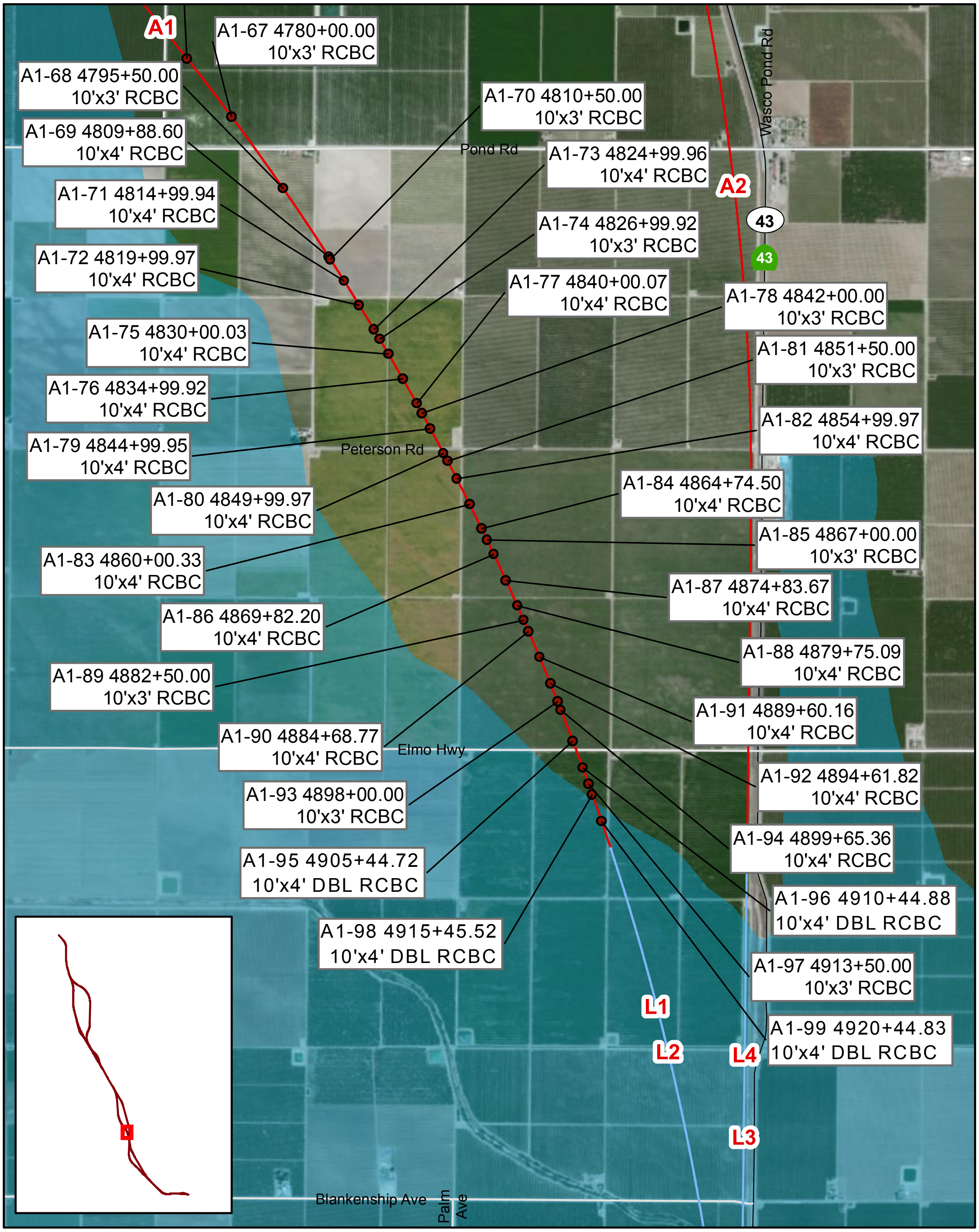
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-46
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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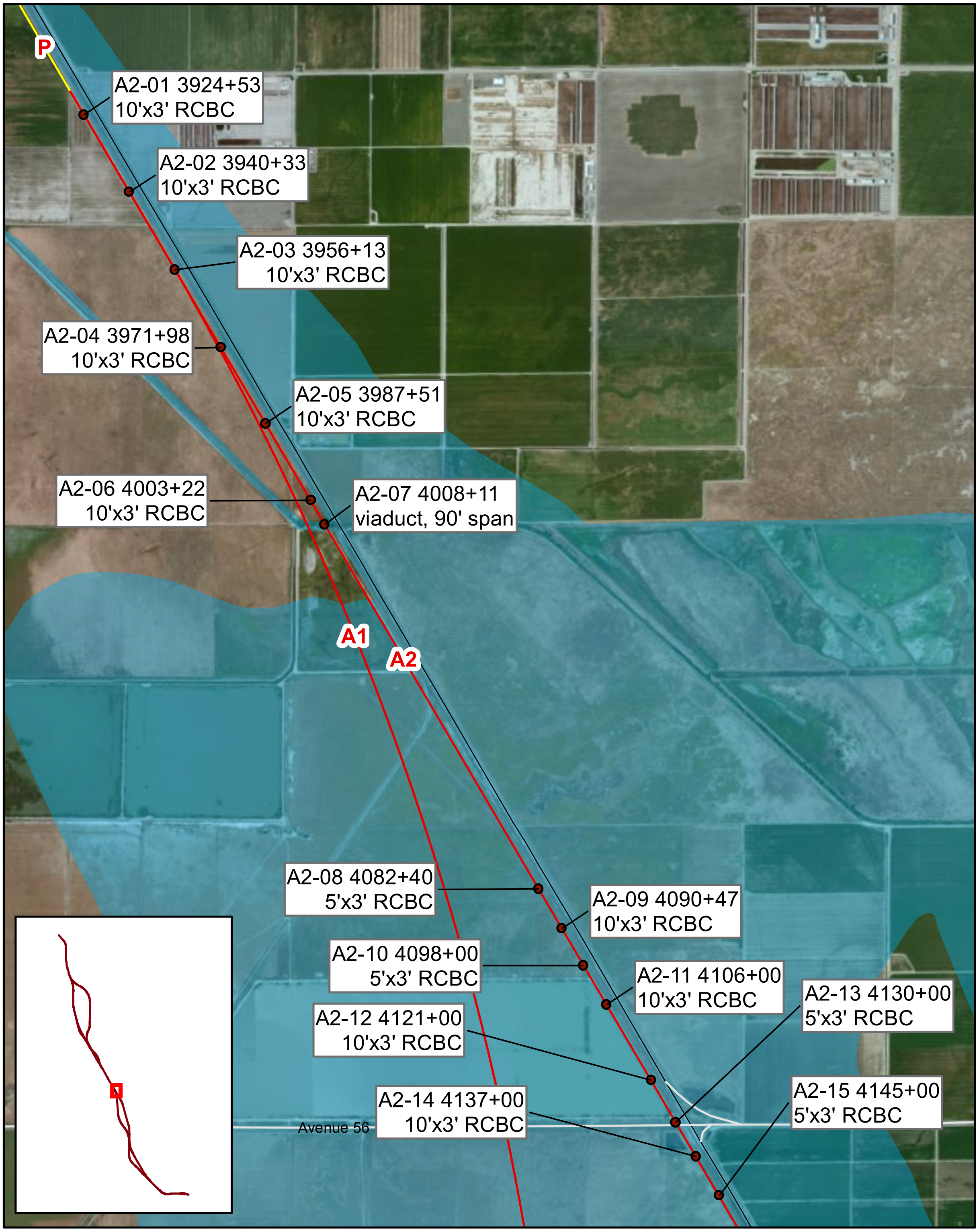
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-47
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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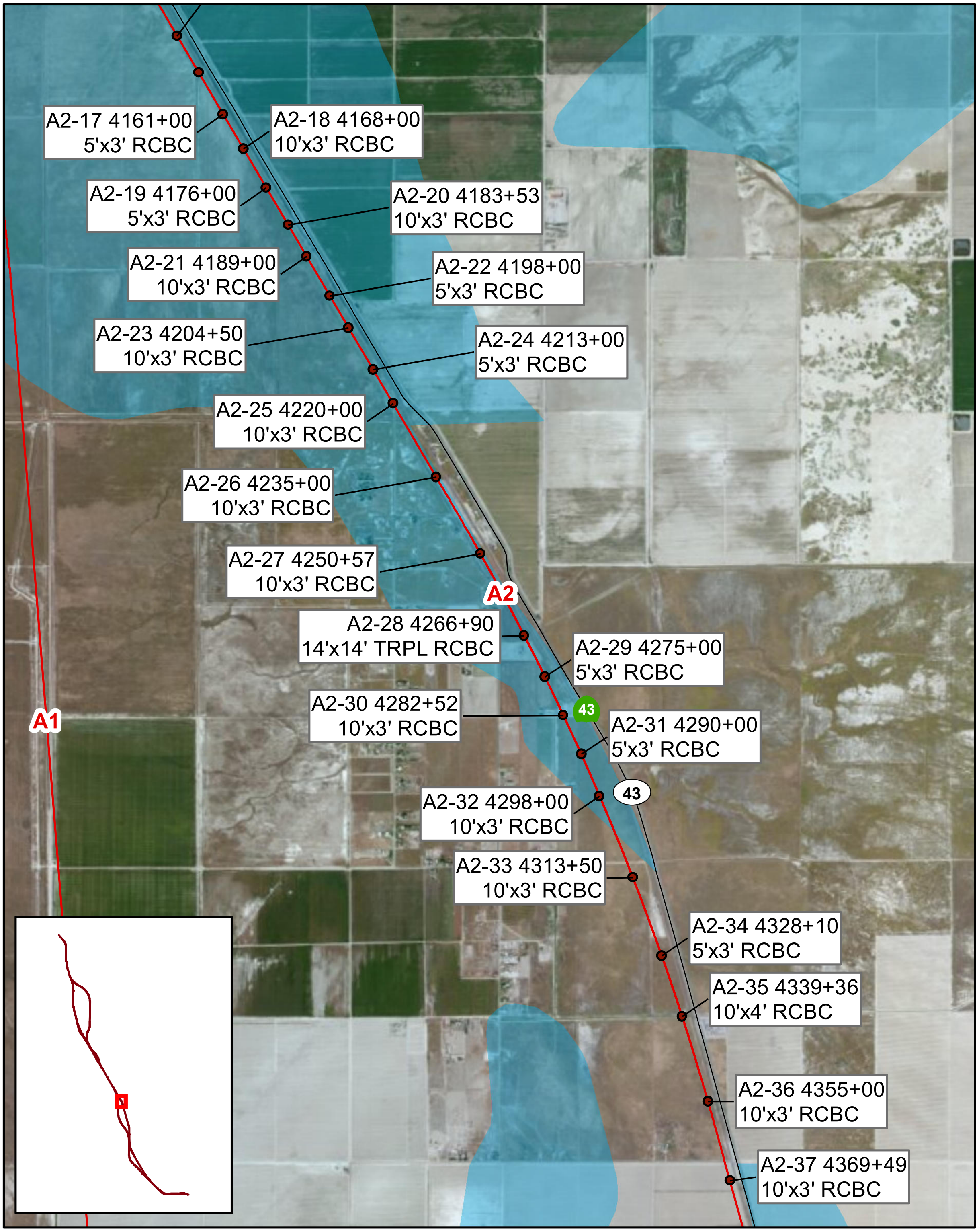
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-48
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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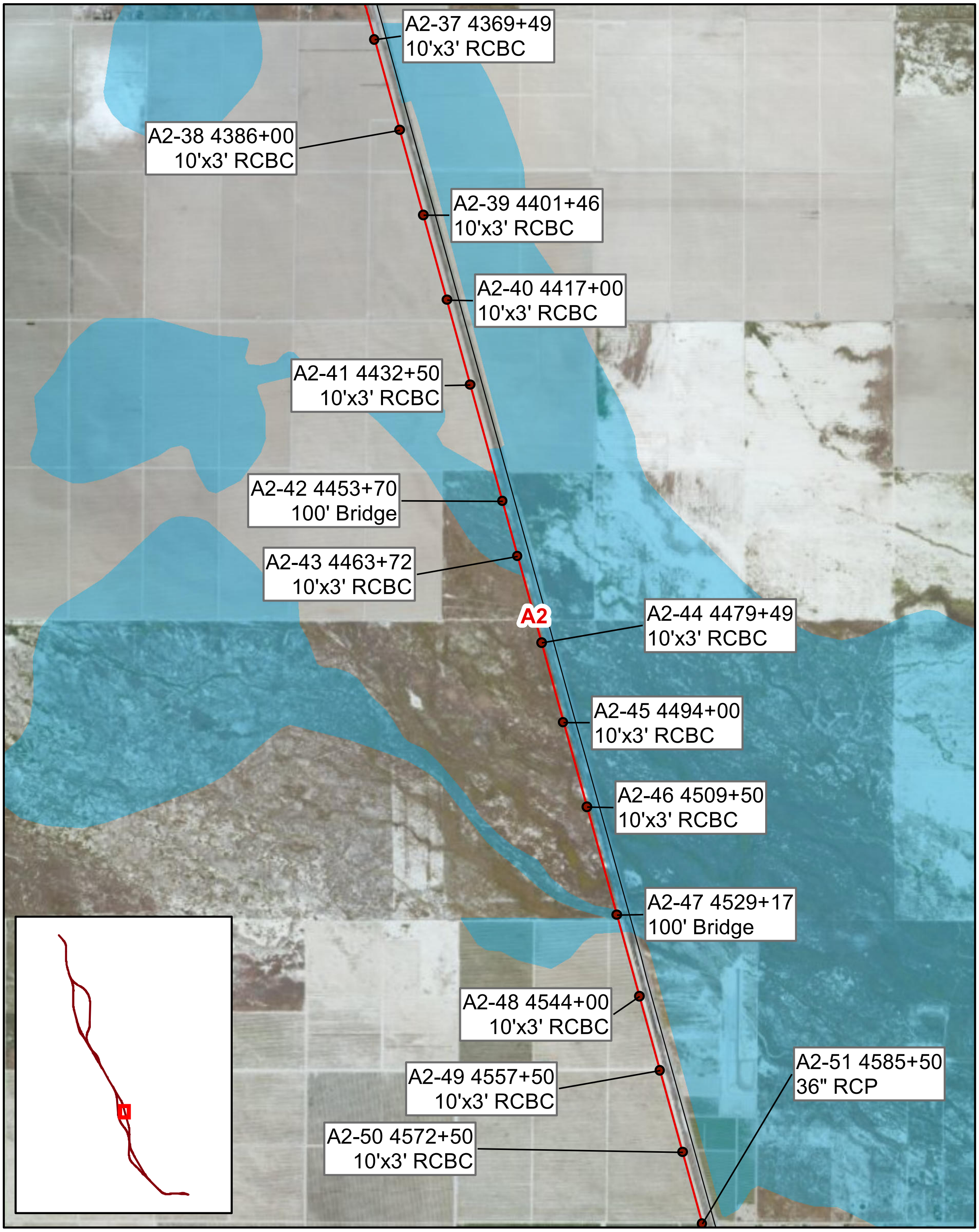
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-49
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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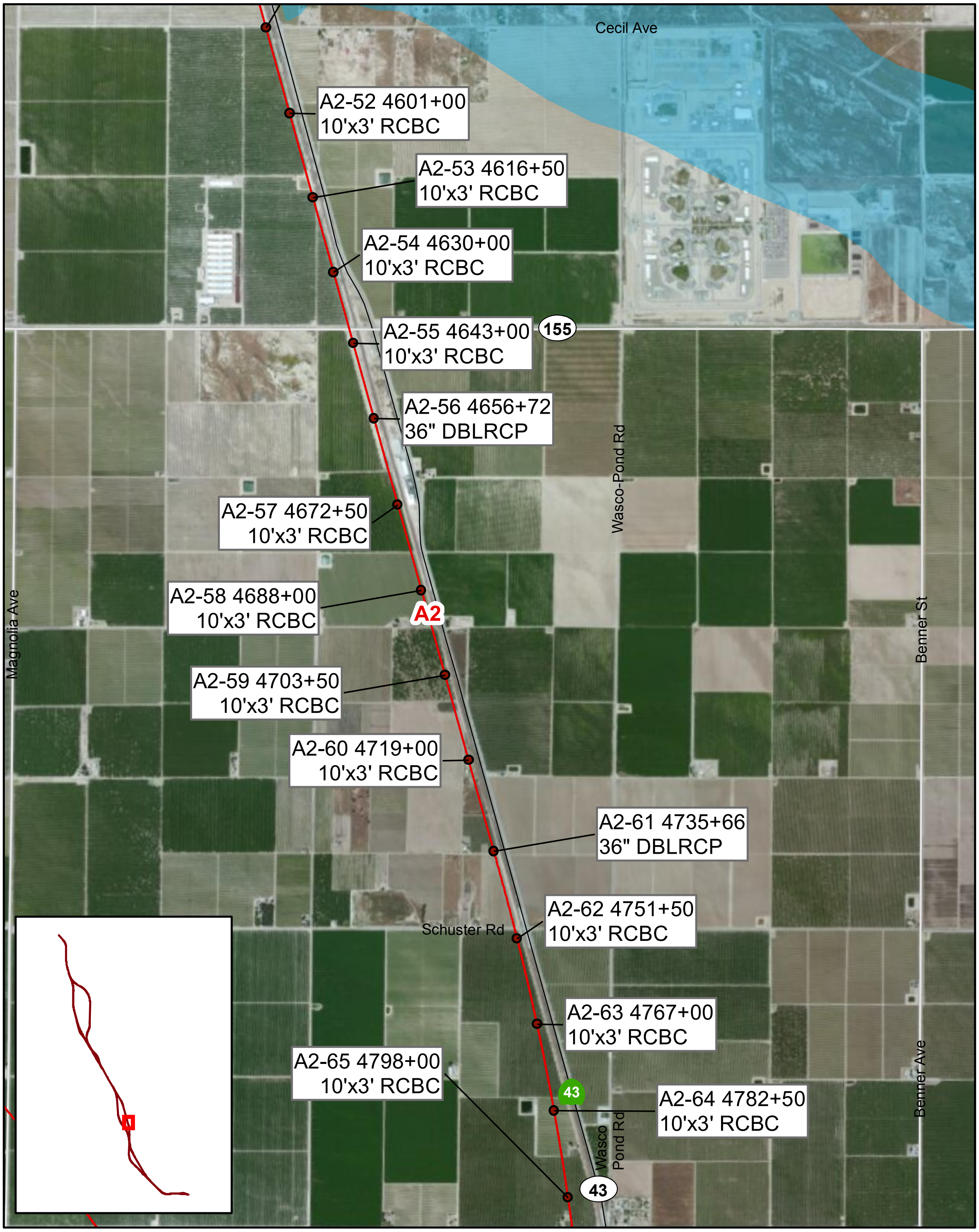
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-50
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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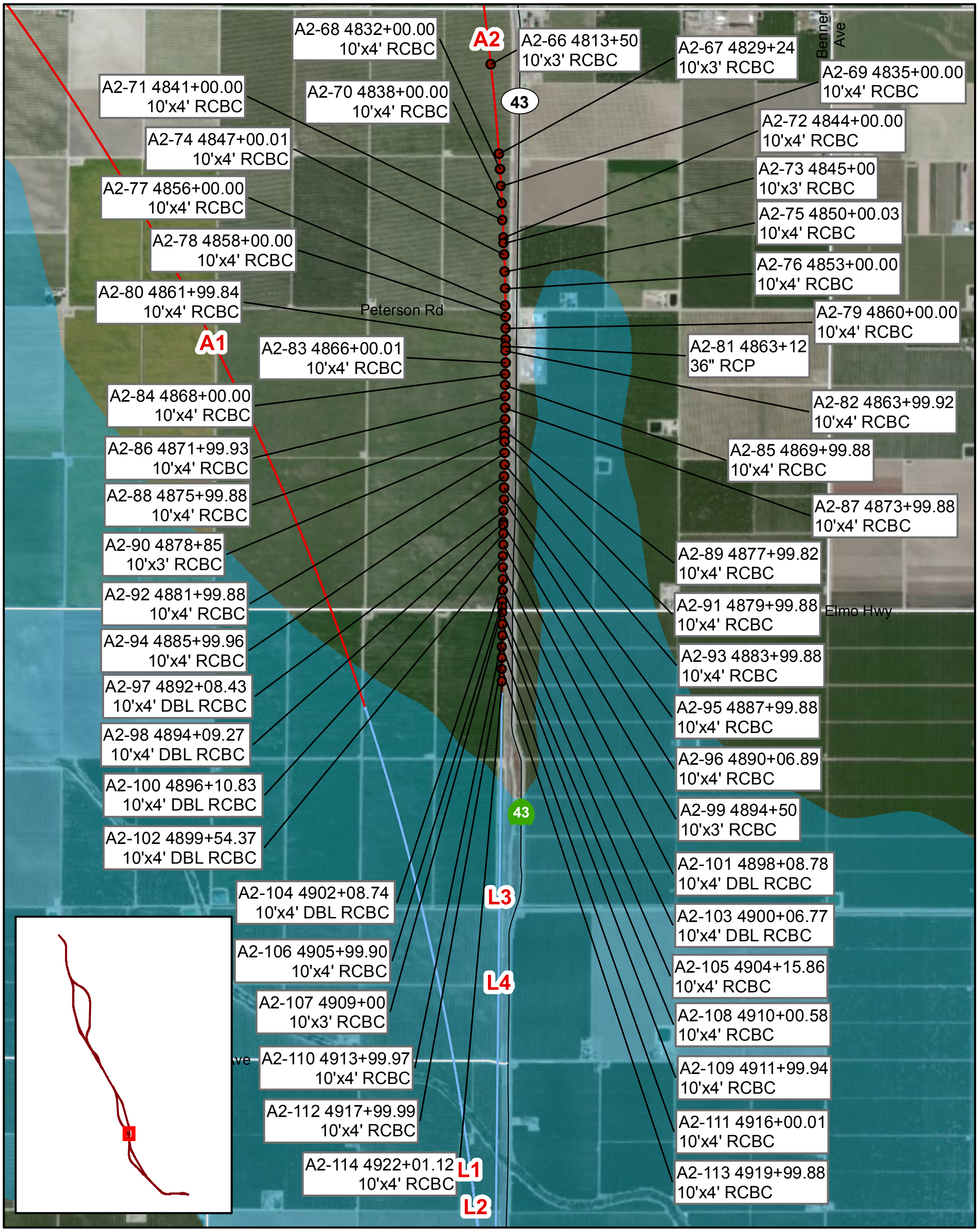
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-51
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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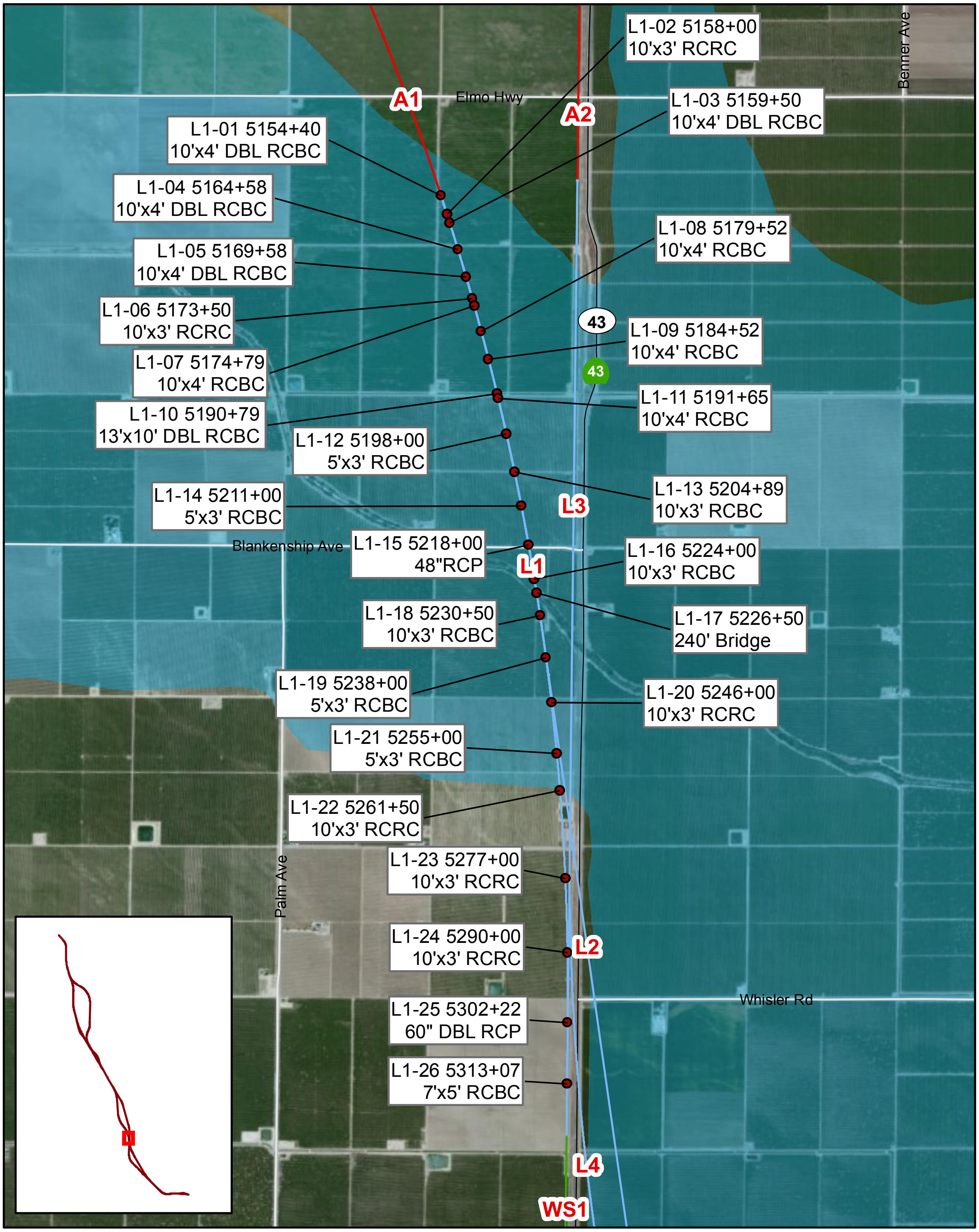
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-52
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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N

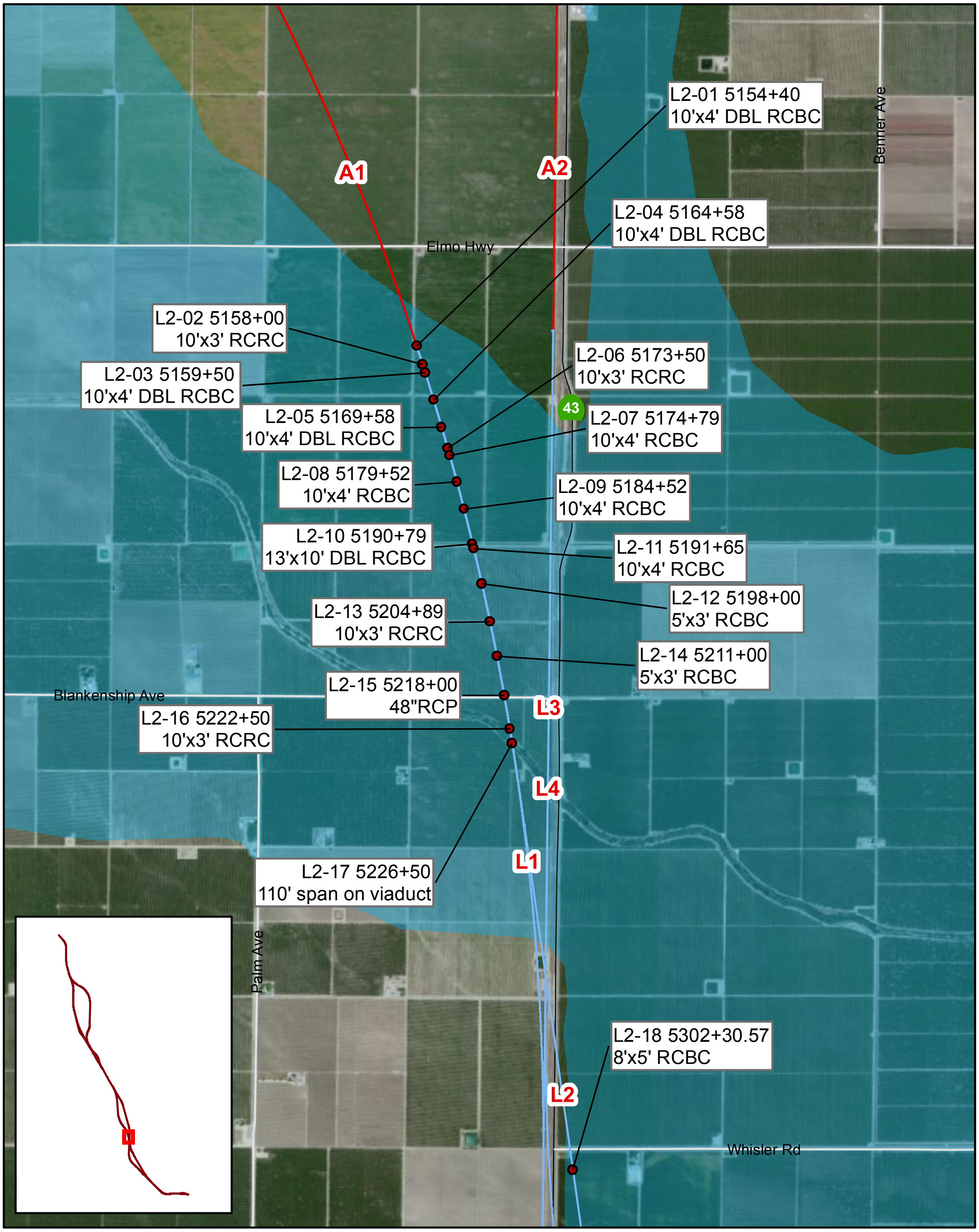
0 1,250 2,500
Feet
0 500 1,000
Meters

- CVFPB Designated Floodways
- Hydraulic Crossing Point
- 100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

Figure A-53

Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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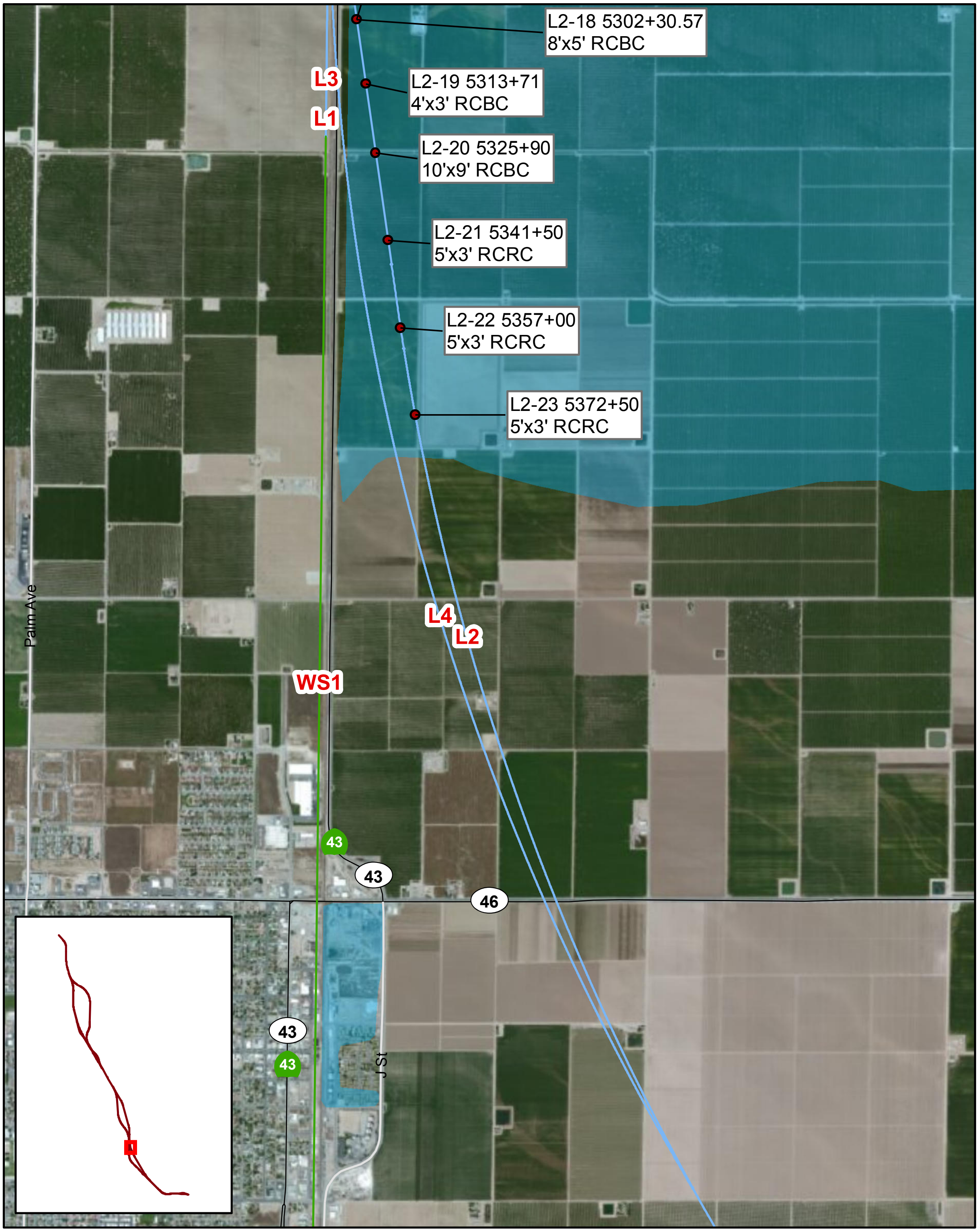
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-54
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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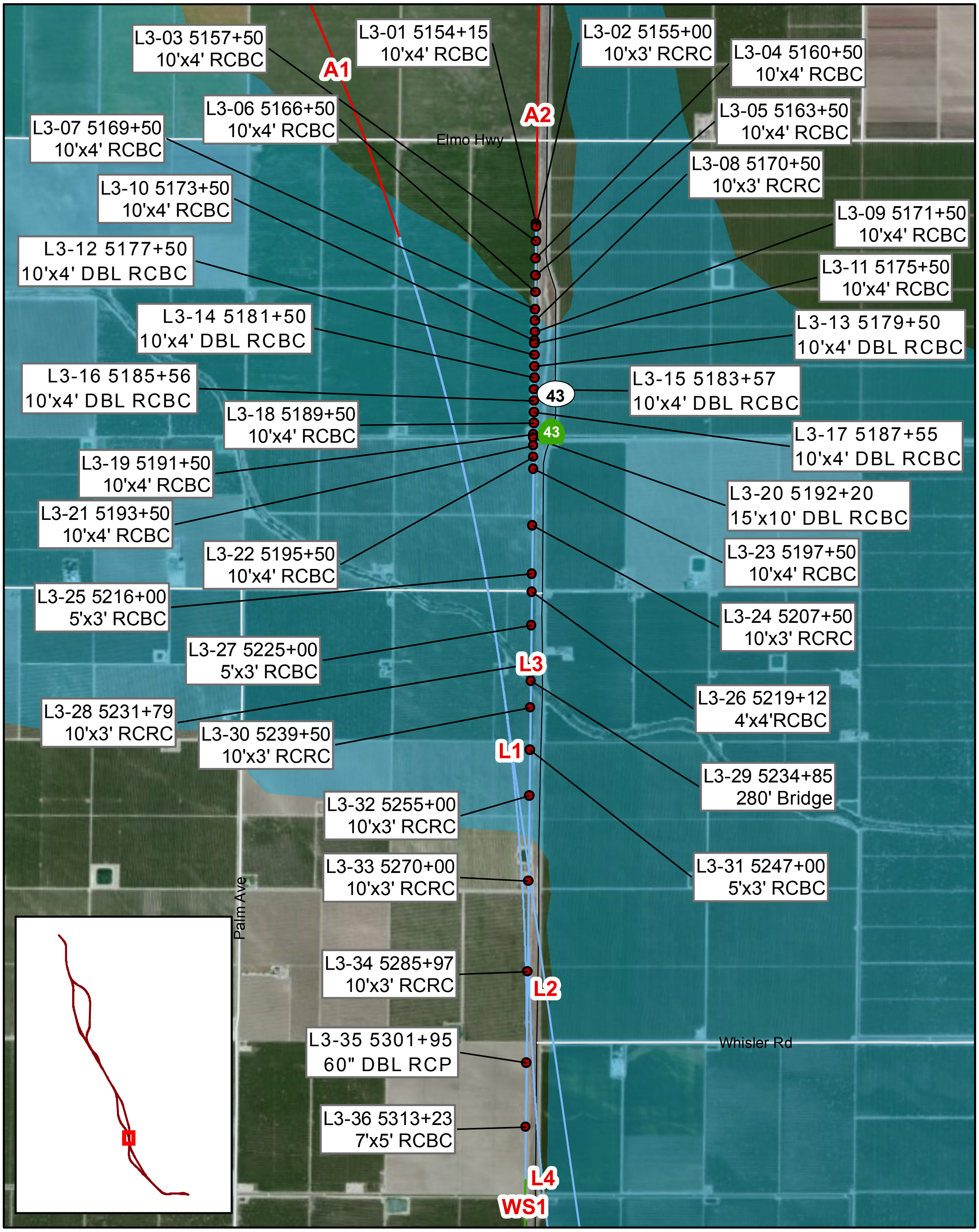
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-55
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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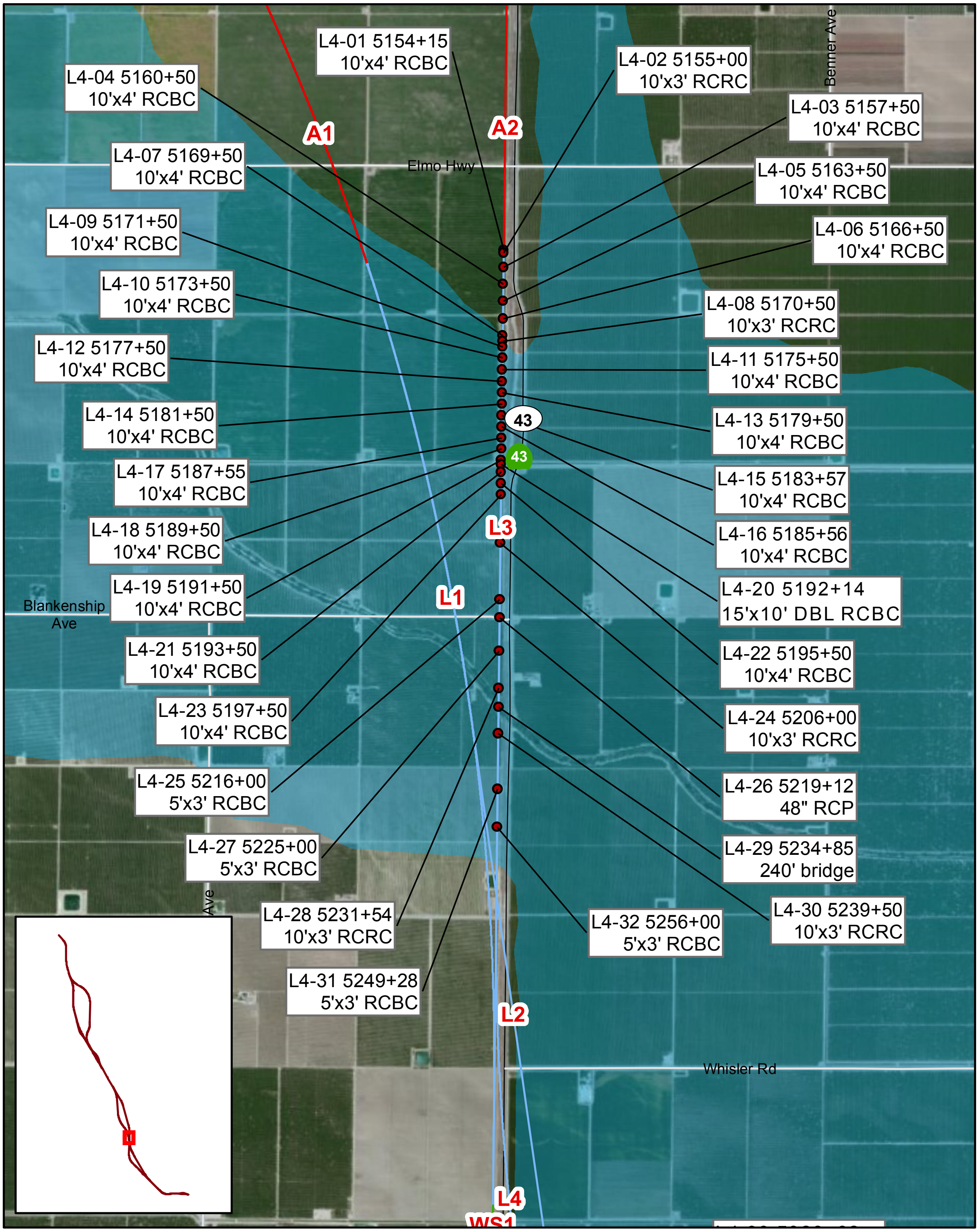
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-56
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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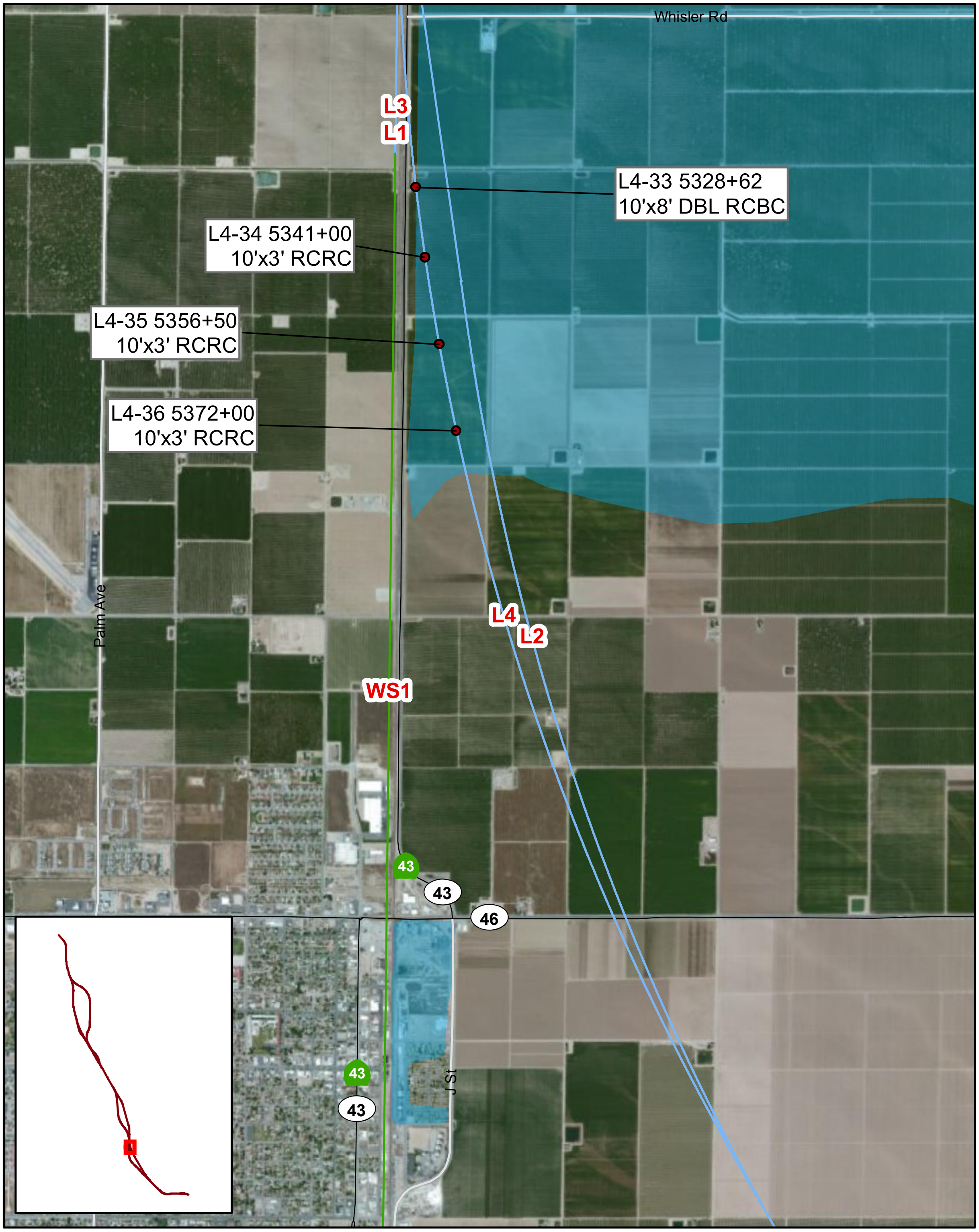
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-57
Hydraulic Crossing Points



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Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

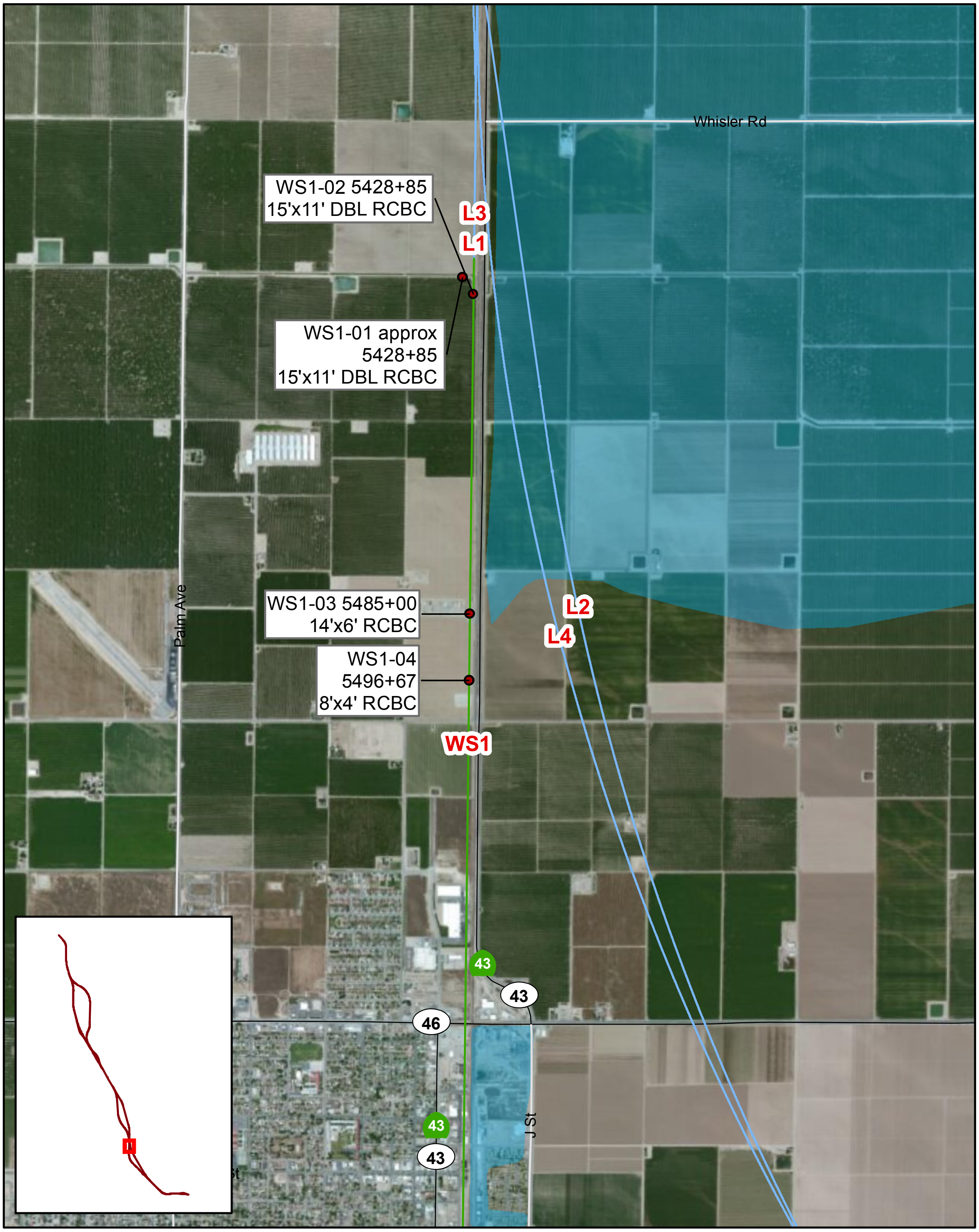
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-58
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-59
Hydraulic Crossing Points

Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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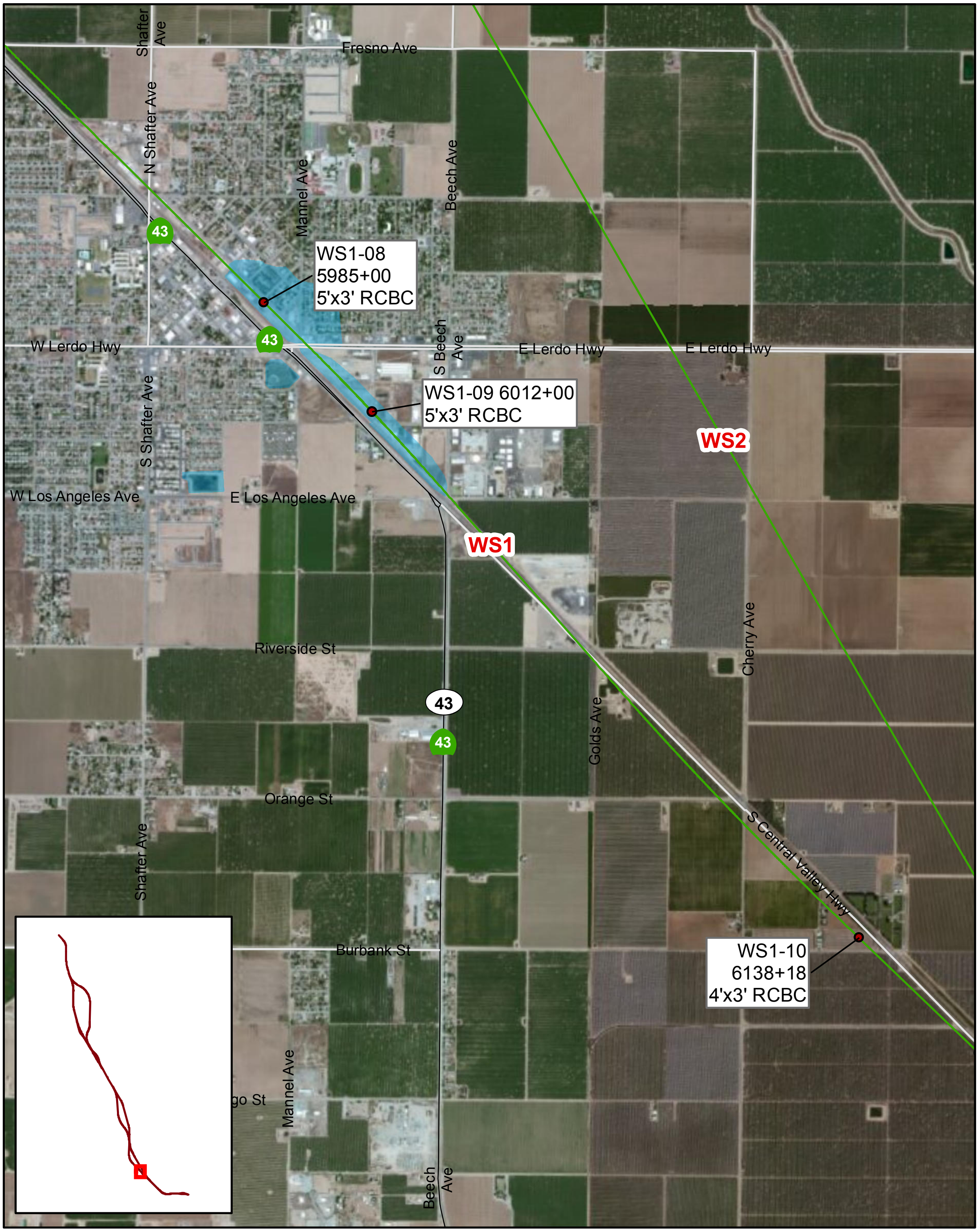
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-60
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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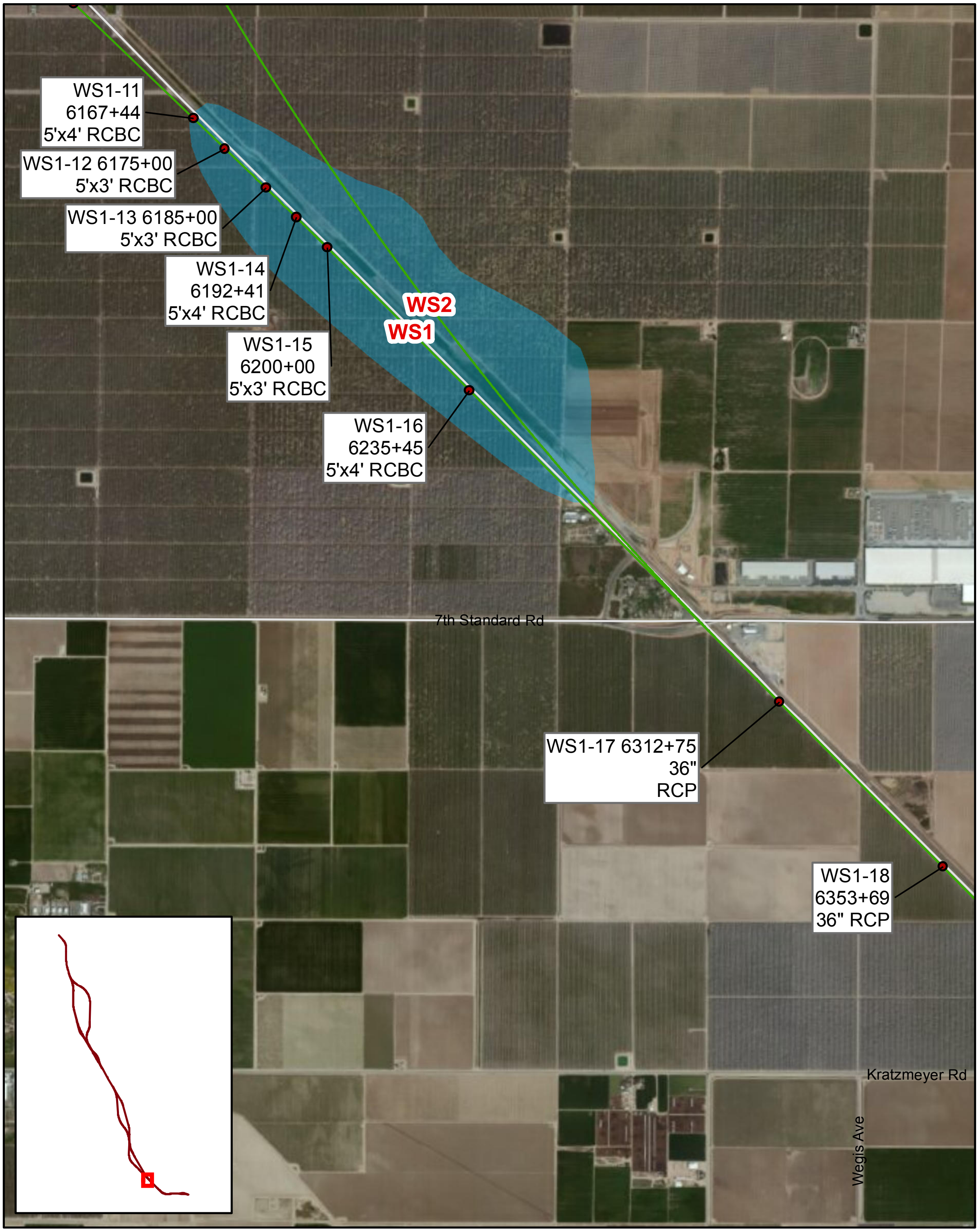
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-61
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-62
Hydraulic Crossing Points

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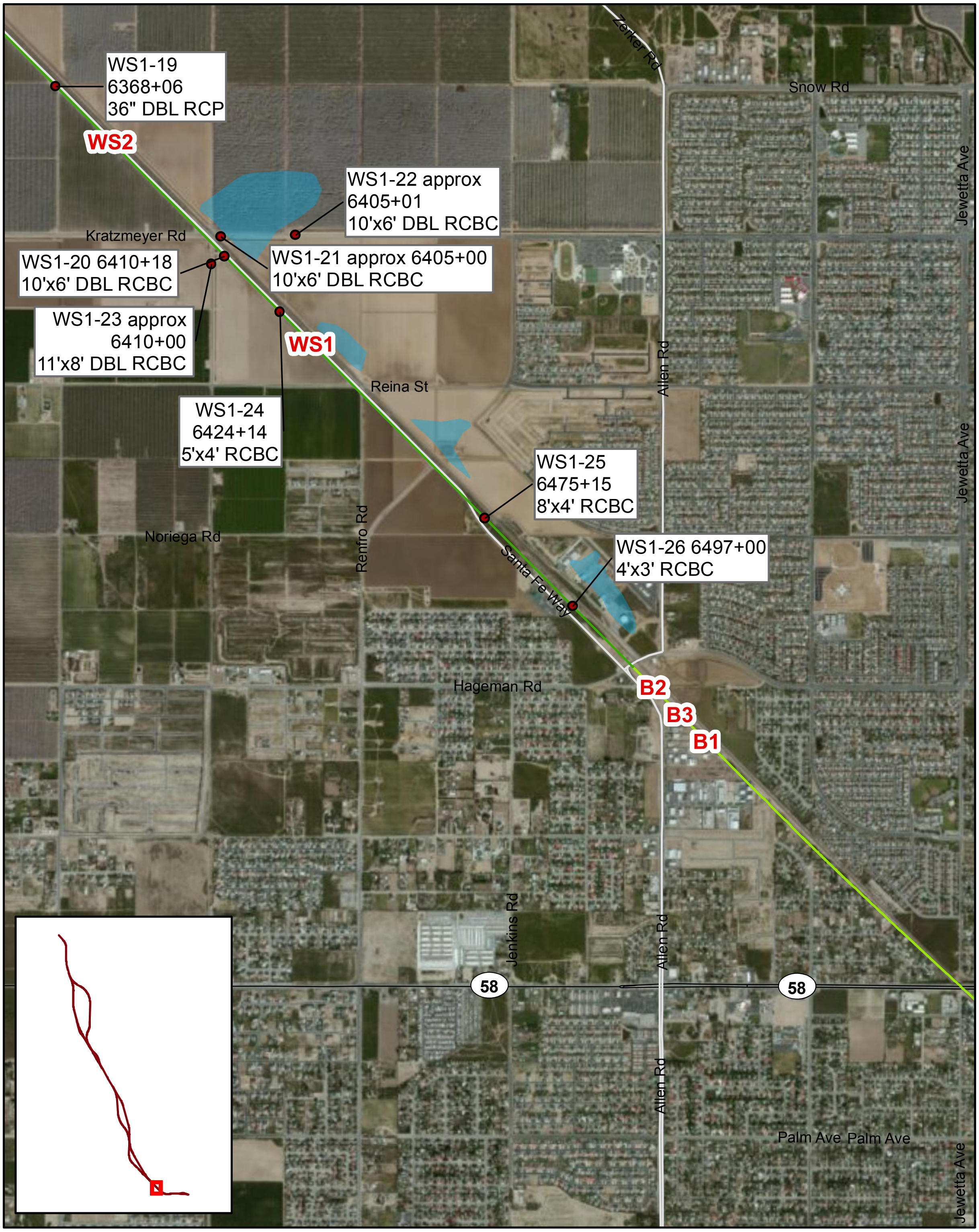

Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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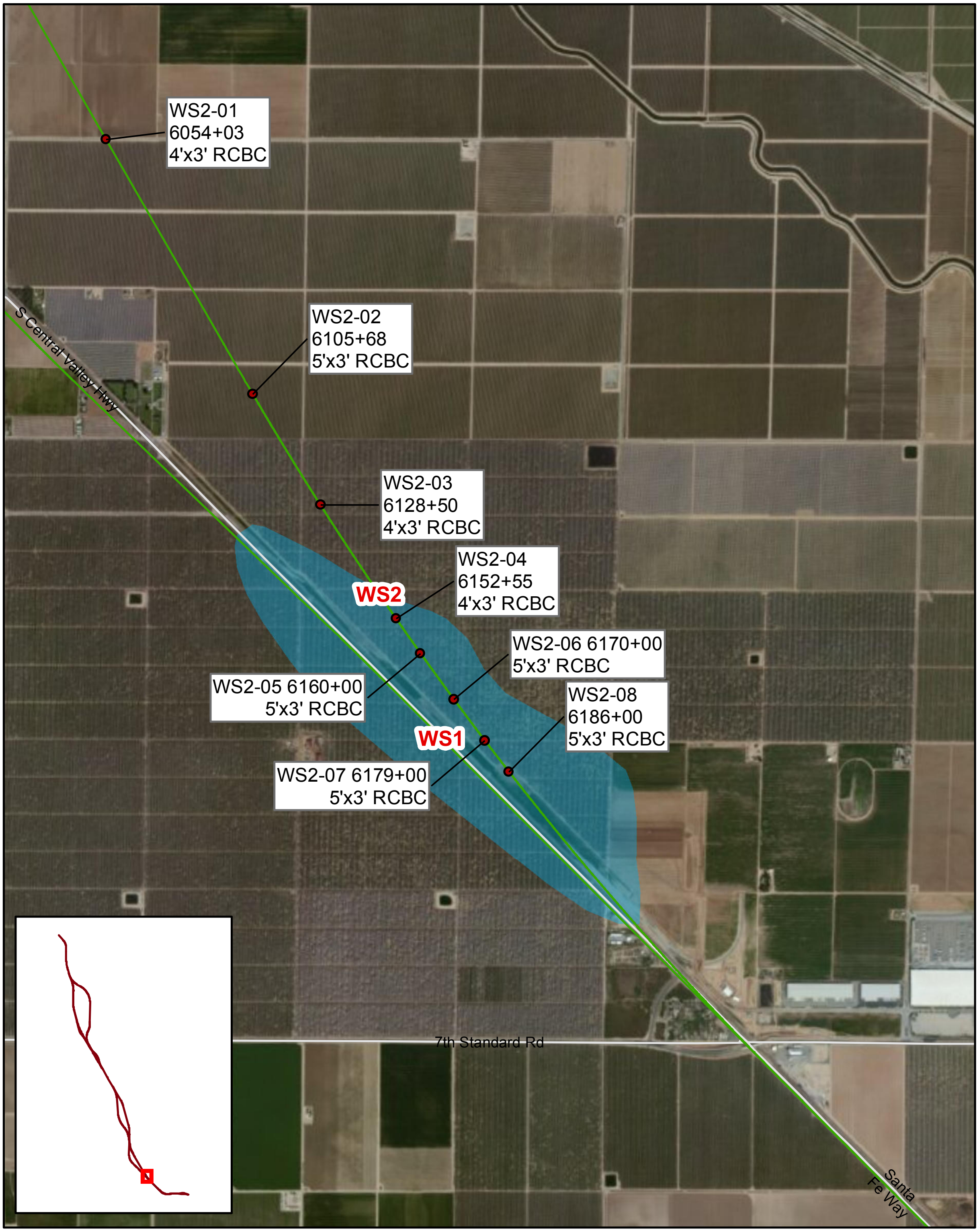
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-63
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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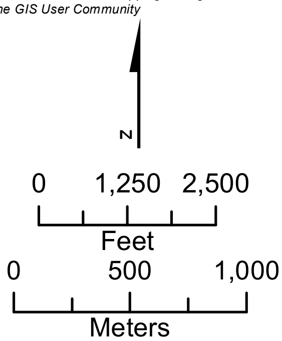
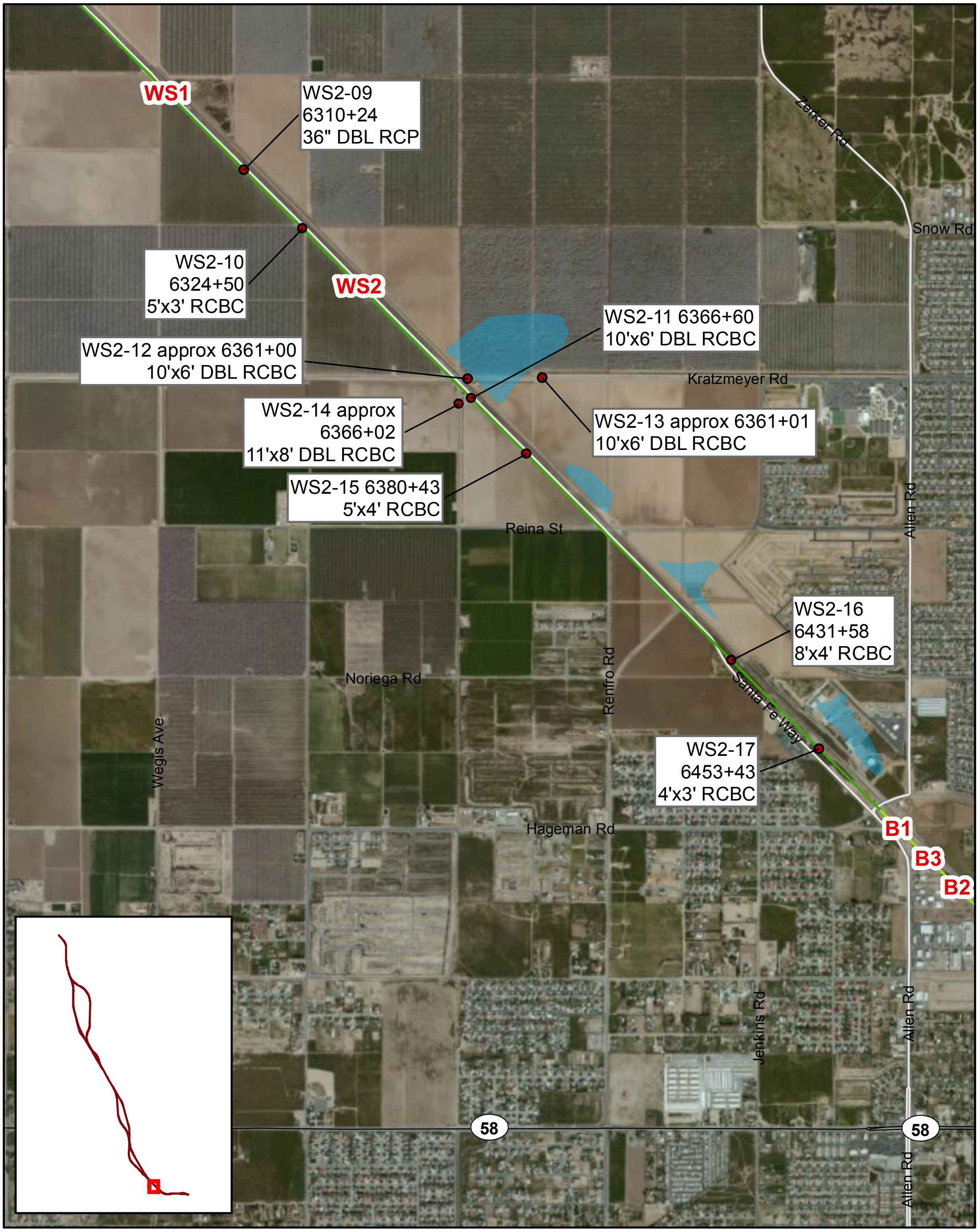


CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

Figure A-64
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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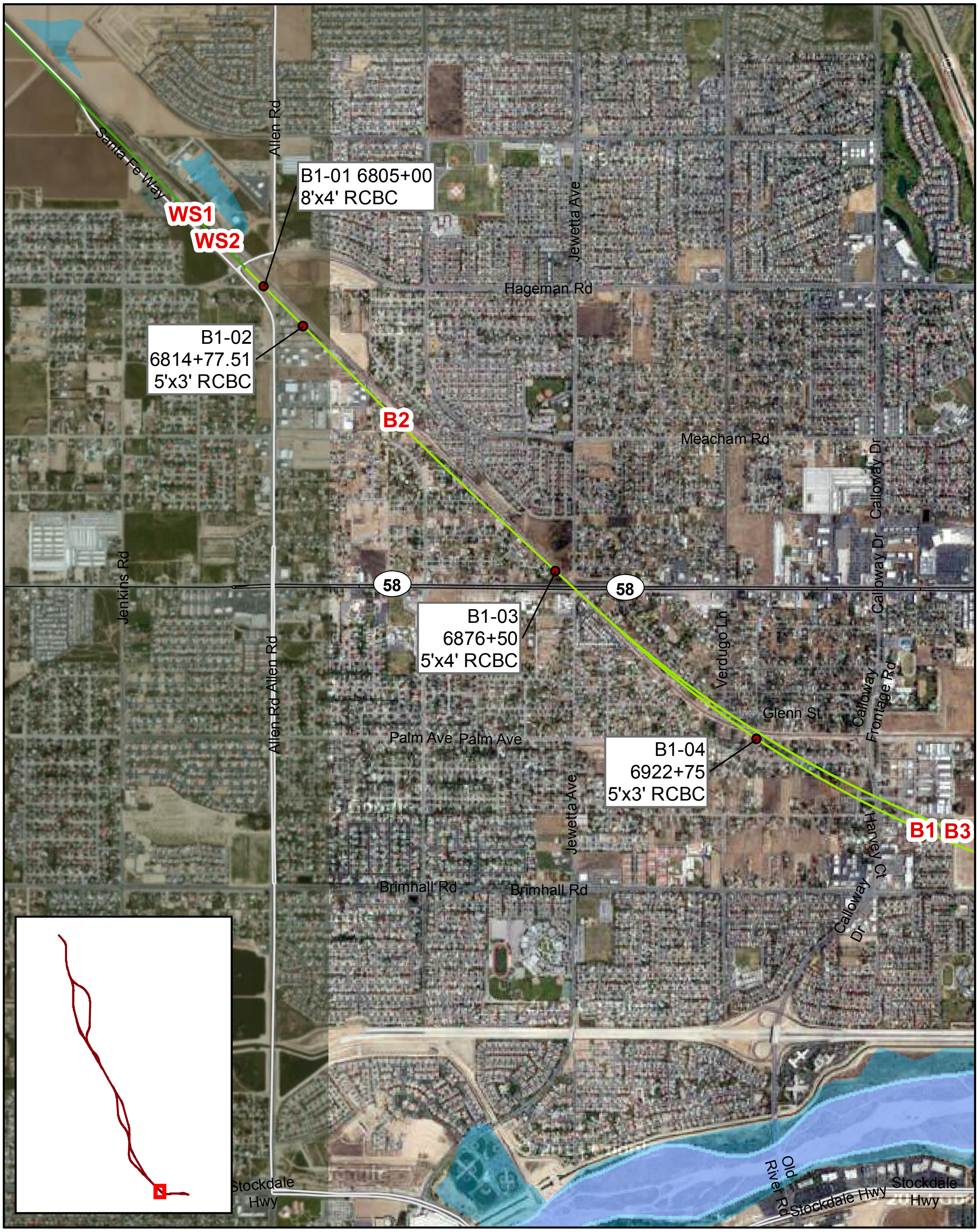
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-65
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

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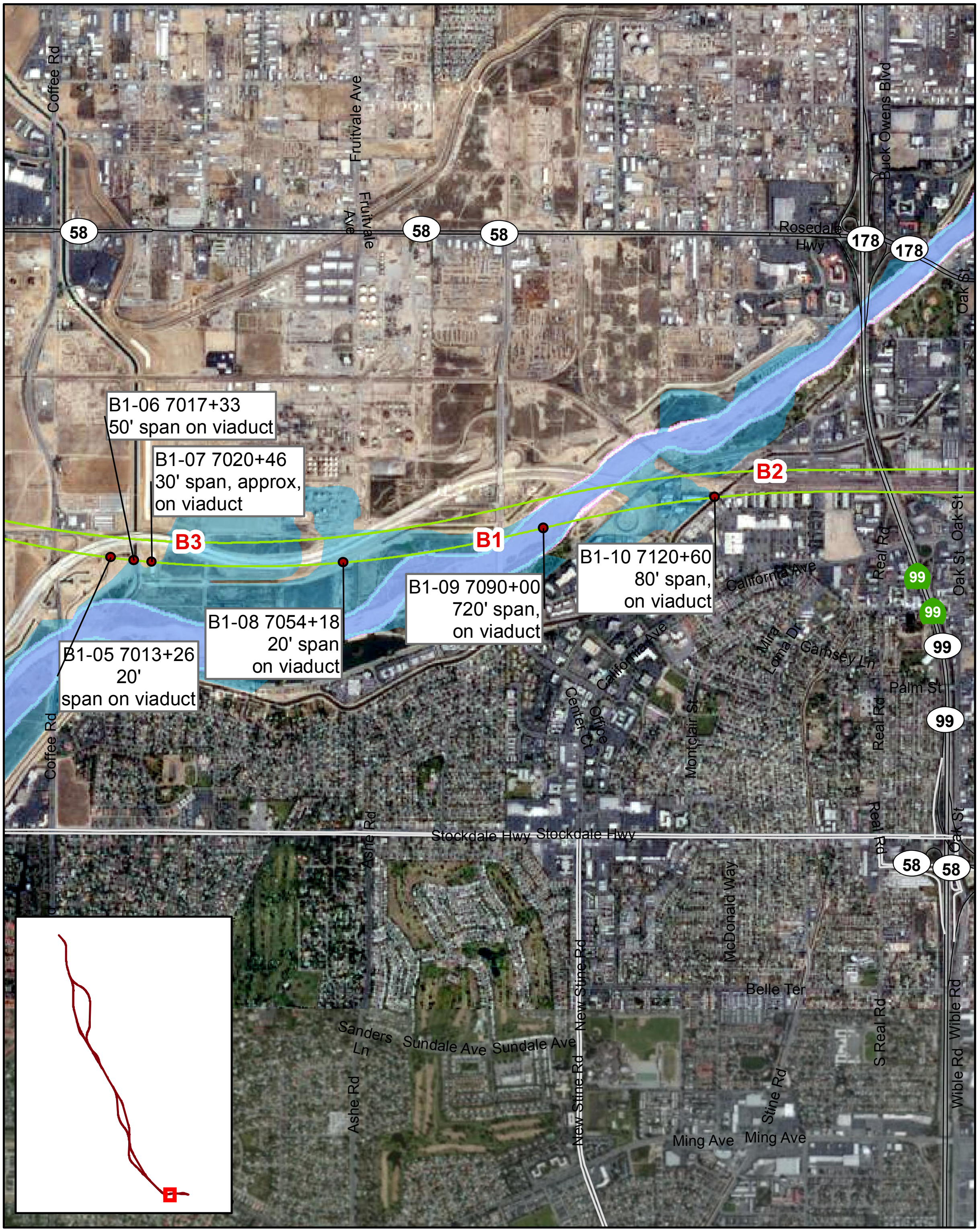
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-66
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013

CVFPB Designated Floodways

Hydraulic Crossing Point

100 Year Flood Zones

Alignment Alternatives

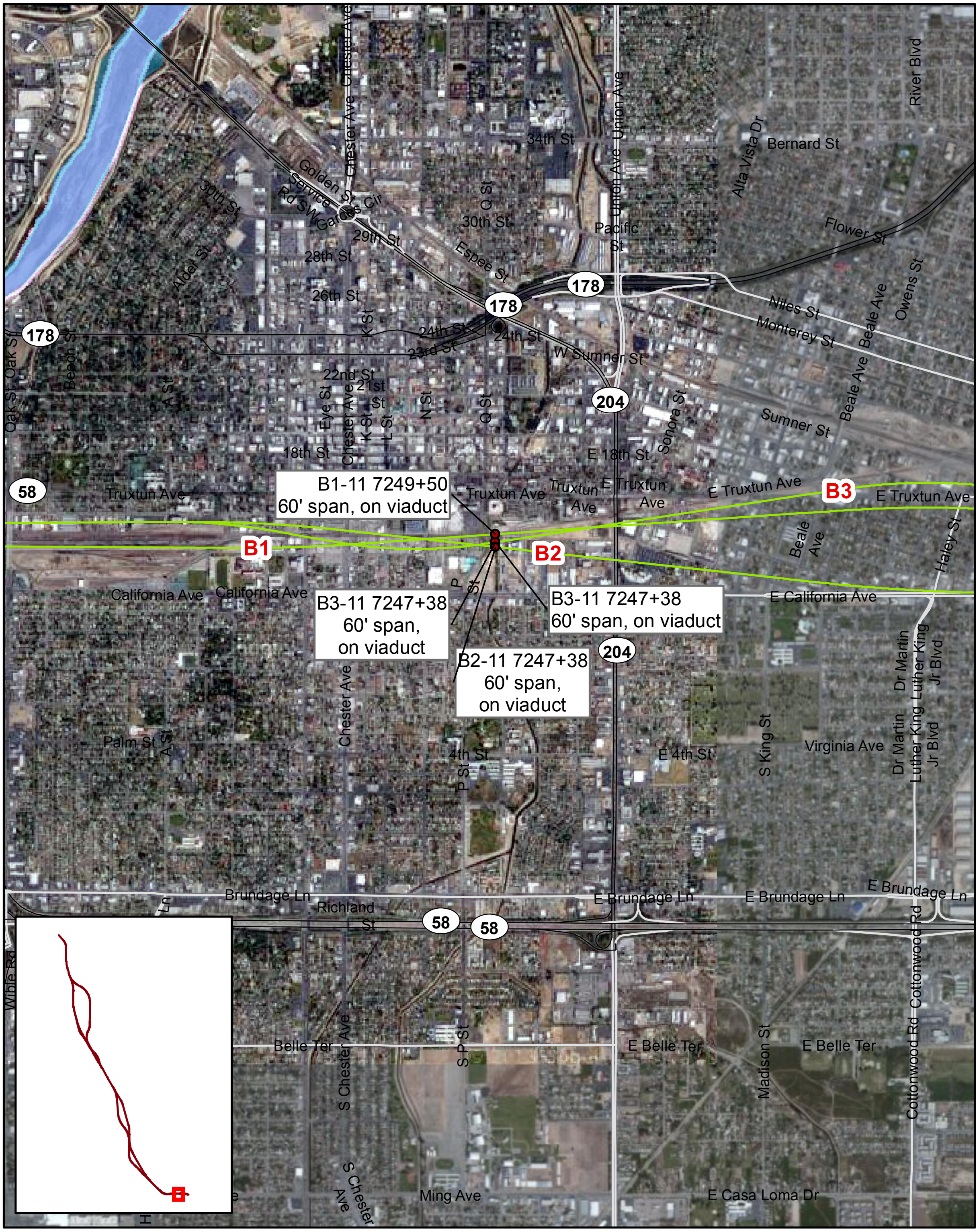
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-67

Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013

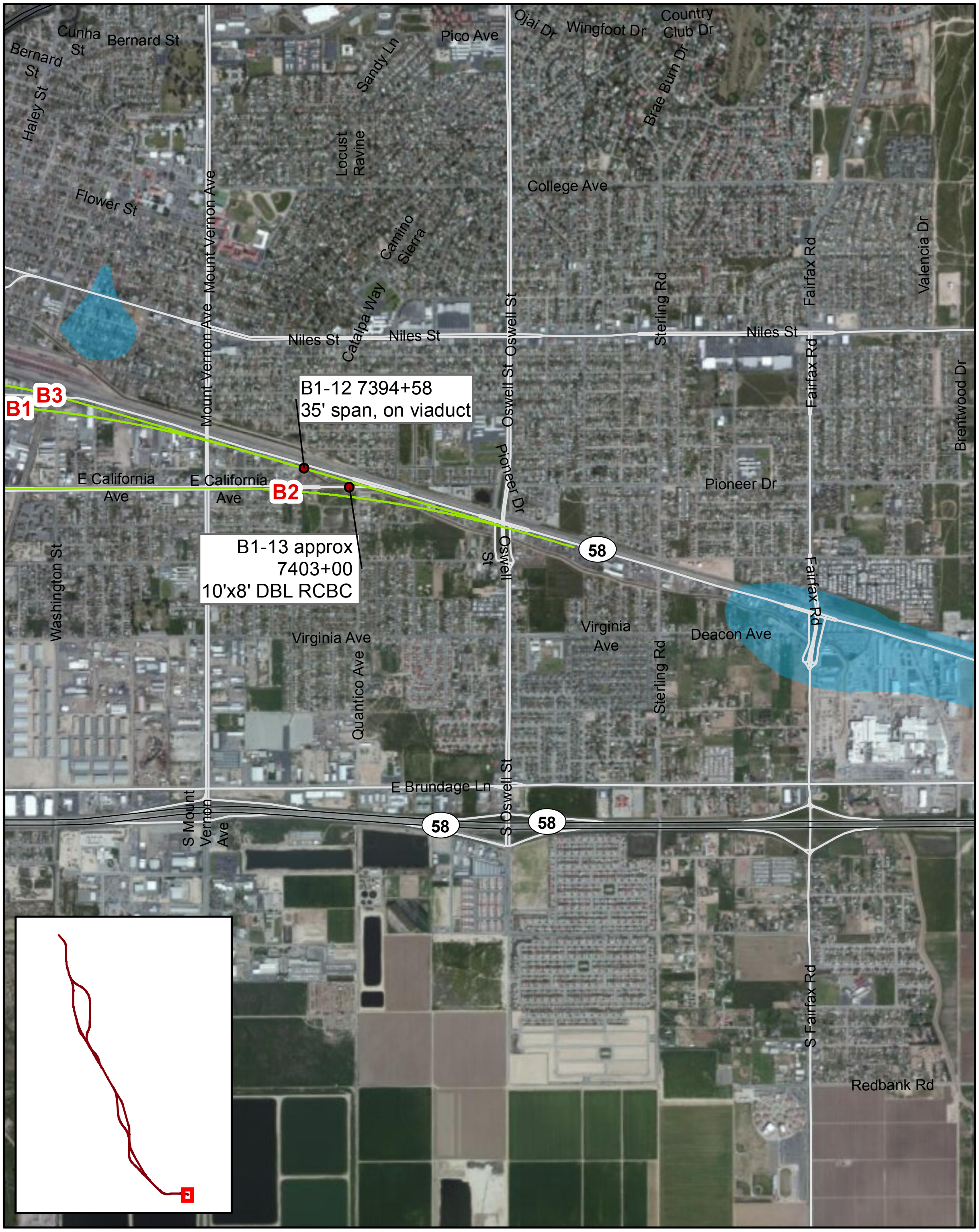
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-68
Hydraulic Crossing Points



December 2013

Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

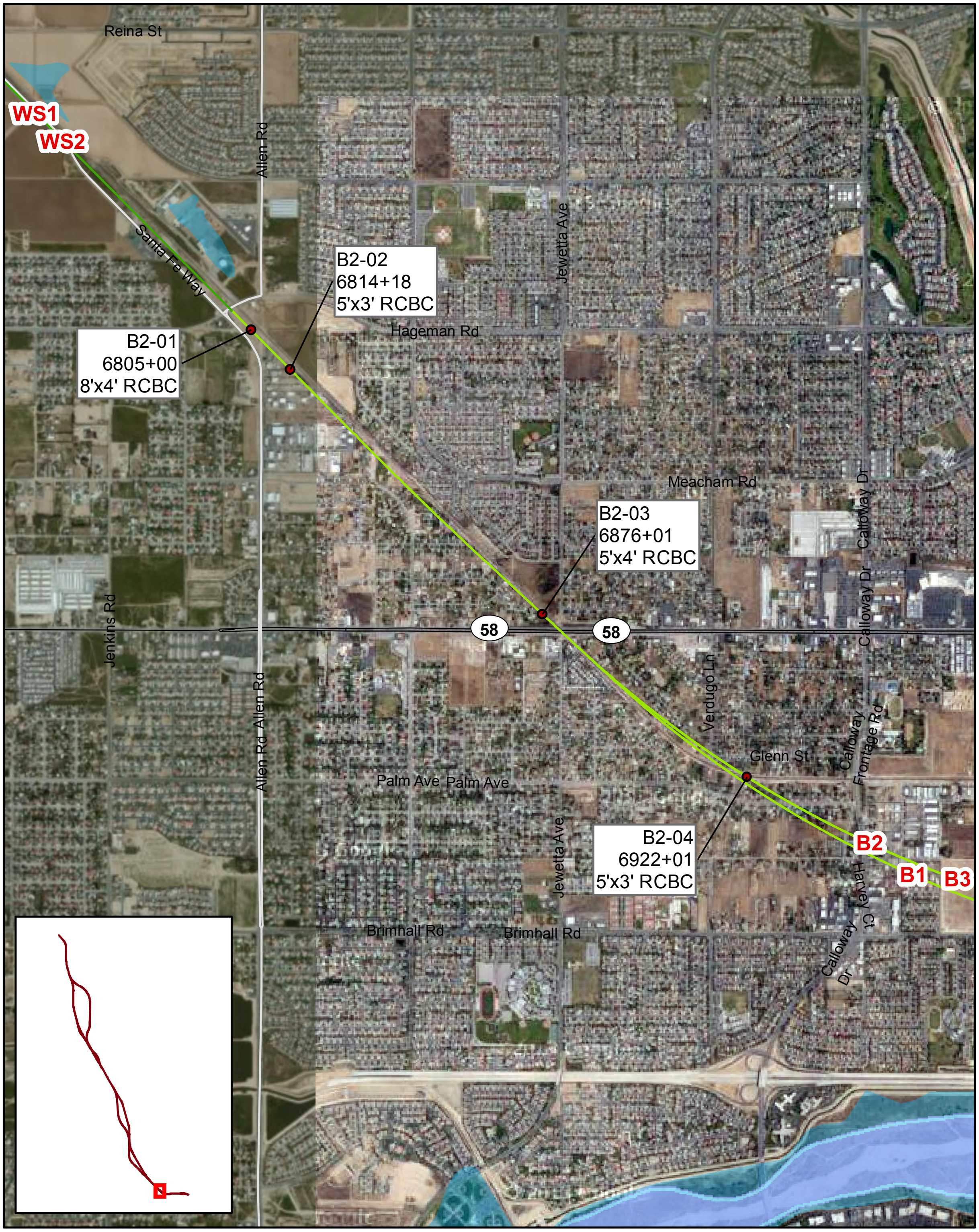
N

0 1,250 2,500
Feet
0 500 1,000
Meters

CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

Figure A-69
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013

CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

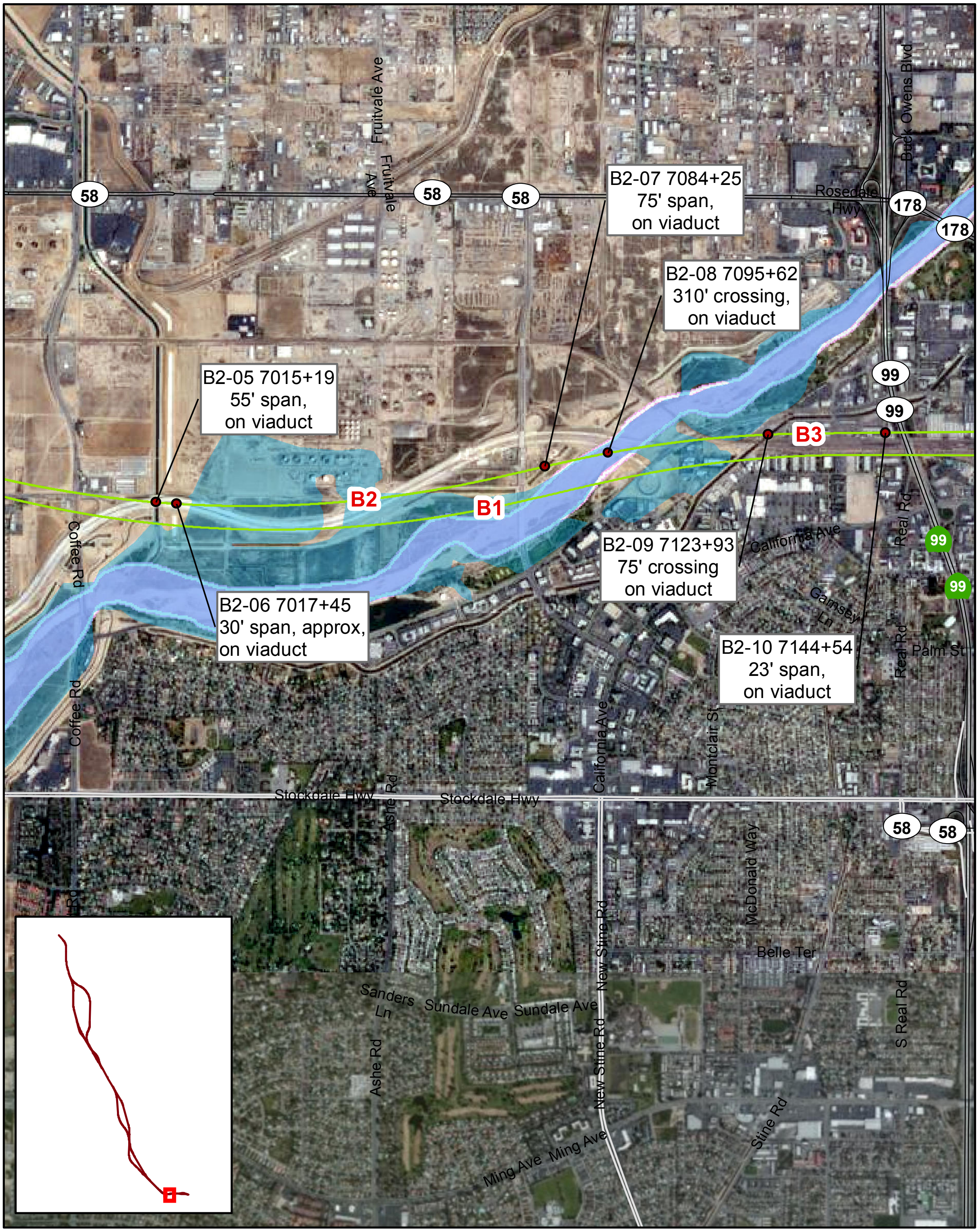
Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-70
Hydraulic Crossing Points

RFP No. HSR 14-32 – INITIAL RELEASE - 05/27/2015



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013

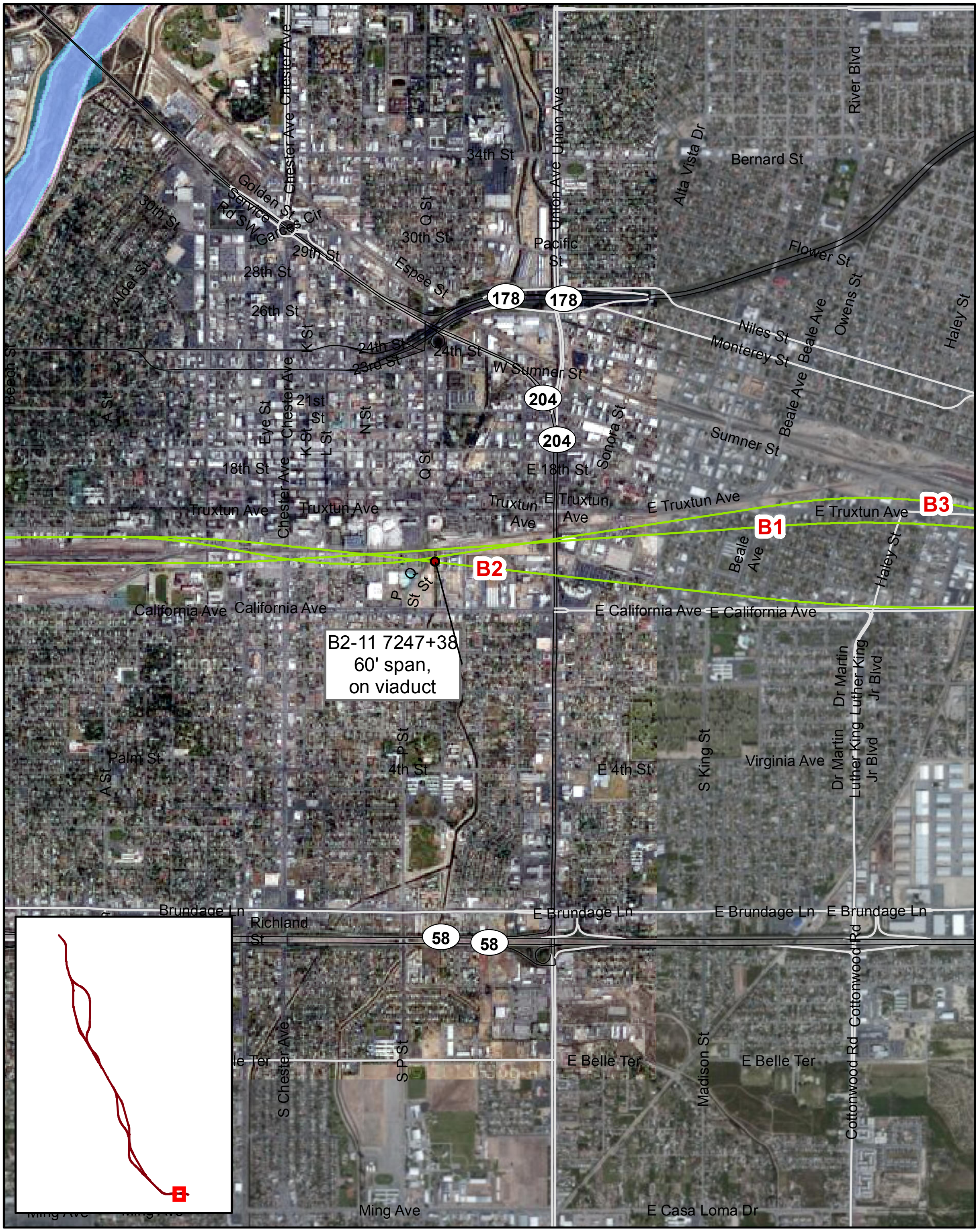
N

0 1,250 2,500
Feet
0 500 1,000
Meters

CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

Figure A-71
Hydraulic Crossing Points



December 2013

Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

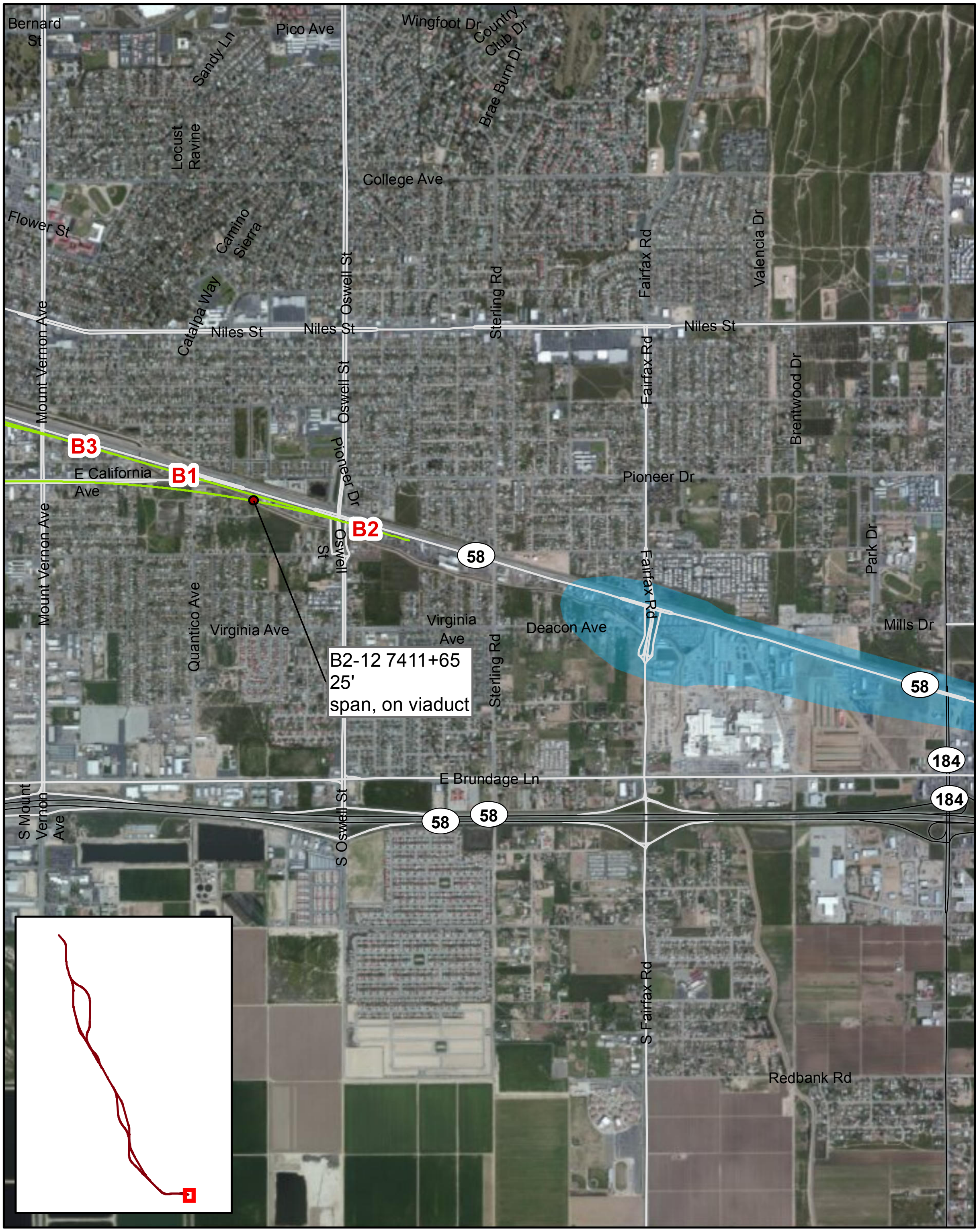
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-72
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013

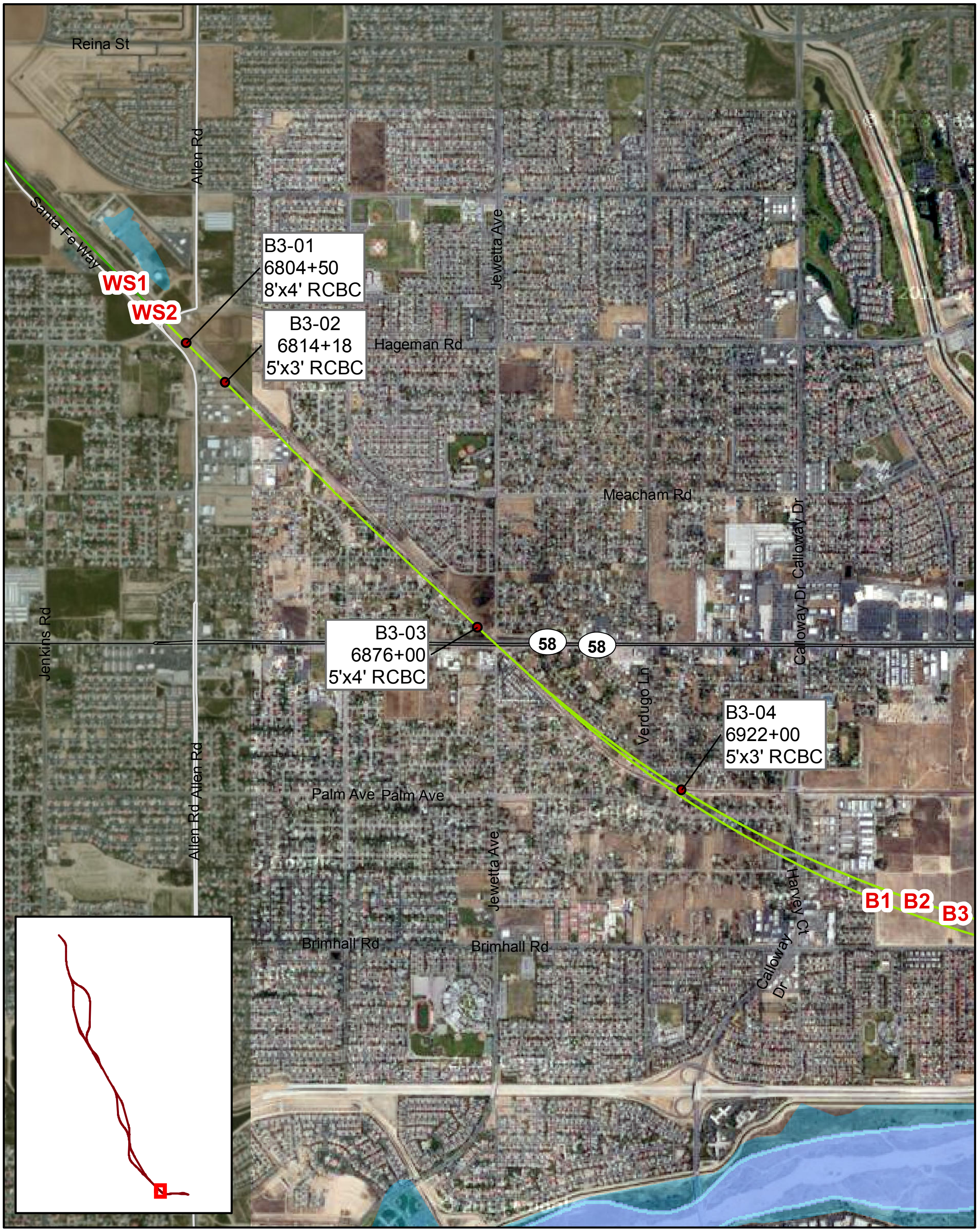
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
F1
M
H, HW, HW2
K1, K2, K3, K4, K5, K6
C1, C2, C3
P
A1, A2
L1, L2, L3, L4
WS1, WS2
B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-73
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013

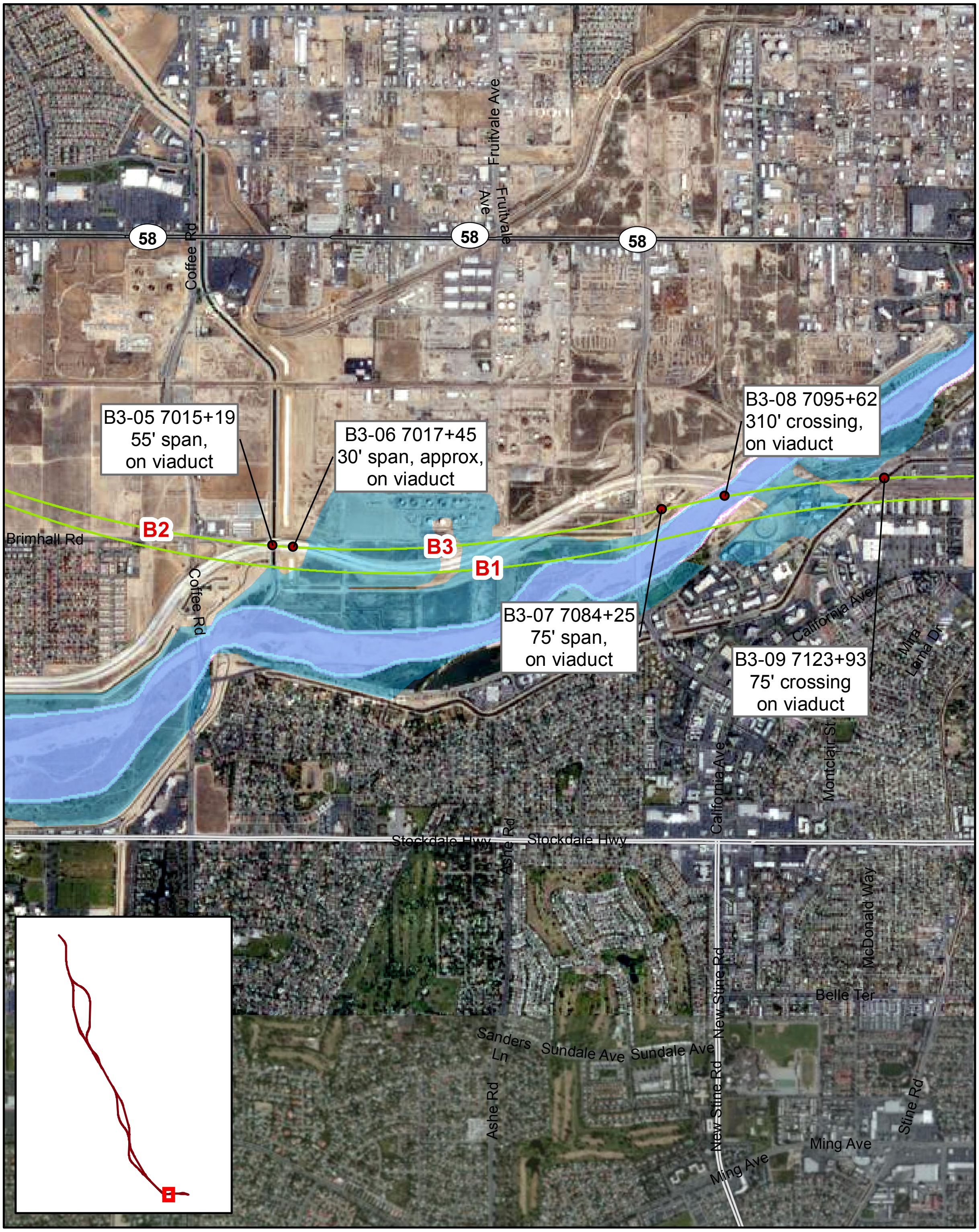
CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

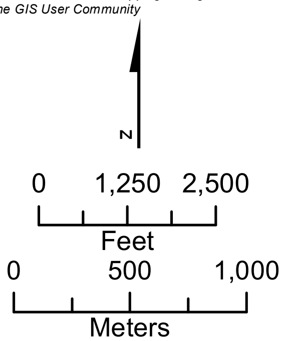
0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-74
Hydraulic Crossing Points



Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013



CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

Figure A-75

Hydraulic Crossing Points

Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013

CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

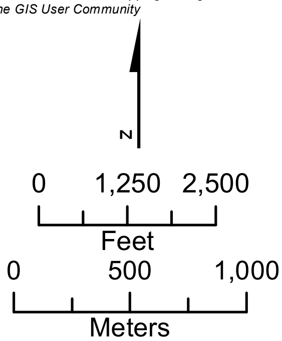


Figure A-76
Hydraulic Crossing Points

Source: Flood zone - FEMA DFIRM
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

December 2013

CVFPB Designated Floodways
Hydraulic Crossing Point
100 Year Flood Zones

Alignment Alternatives
- F1
- M
- H, HW, HW2
- K1, K2, K3, K4, K5, K6
- C1, C2, C3
- P
- A1, A2
- L1, L2, L3, L4
- WS1, WS2
- B1, B2, B3

N

0 1,250 2,500
Feet
0 500 1,000
Meters

Figure A-77
Hydraulic Crossing Points

Appendix B
Hydraulic Crossing Points

ZONE	COUNTY	HST ALIGN	Easting	Northing	Point ID	Sta #	Proposed Facility (internal width x internal height)	Purpose/ Existing Feature Crossed	Crossing angle (clockwise from North)	ROW width (ft)	additional dist. either side (ft)	Total length of channel spanned by culvert (ft)	Existing Elevation (of INV)	Proposed Elevation (of track)	Distance to Top of Rail (ft)
Z4	FRE	F1	6332371	2146715.3	F-01	0337+76	42" siphon	Braly No.14	90.00	80	25	105	286.51	287.09	0.5
Z4	FRE	F1	6335839	2142748.2	F-02	390+50	36" siphon	stormwater siphon	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Z4	FRE	F1	6339406	2137495.6	F-03	0454+13	48", 42" RGRCPs	Fresno Colony Canal No. 24	140.00	80	25.00	130	289	333.97	44.9
Z4	FRE	F1	6340766	2133869.3	F-04	0492+90	4' x5' RCBC	North Central Canal No. 26	93.00	80	25.00	130	290.03	332.1	42.0
Z4	FRE	F1	6341374	2130768.5	F-05	0524+54	16'x6' DBL RCBC	Central Canal No. 23	97.00	130	25.00	180	289.31	300.44	11.14
Z4	FRE	F1	6340352	2130768.5	F-06	approx 0524+50	15'x11' DBL RCBC	Culvert under road, Central Canal	N/A	122	0.00	122	N/A	N/A	N/A
Z4	FRE	F1	6341493	2129427.5	F-07	0538+00	36" DBL RCP	*Unknown (equivalent to adjacent BNSF)*	93.00	130	0.00	130	289.63	300.73	11.10
Z4	FRE	F1	6341520	2128789.7	F-08	0544+39	36" RCP	*Unknown (equivalent to adjacent BNSF)*	92.00	130	0.00	130	290.51	301.01	10.50
Z4	FRE	F1	6341529	2127465.7	F-09	0557+64	6'x4' DBL RCBC	*Periodic hydraulic relief*	90.00	145	0.00	145	288.34	301.59	13.25
Z4	FRE	F1	6341518	2126499.1	F-10	0567+30	*42" RCP*	Viau No. 25	90.00	145	25.00	195	290.52	302.02	11.49
Z4	FRE	F1	6341484	2122862.1	F-11	0603+67	36" RCP	Unknown (equivalent to adjacent BNSF)	90.00	528	0.00	528	289.84	301.56	11.72
Z4	FRE	F1	6341479	2122337.1	F-12	0608+92	4'x3' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	528	0.00	528	289.52	301.28	11.76
Z4	FRE	F1	6341472	2121518.1	F-13	0617+11	8'x5' RCBC	Washington Colony Canal No. 15	90.00	239	25.00	289	288.56	300.85	12.29
Z4	FRE	M	6341444	2118547.3	M-01	0650+00	9'x3' RCBC	Wilson No. 230	90.00	147	25.00	197	290.46	300.31	9.8
Z4	FRE	M	6341427	2116855.3	M-02	0666+91	42" RCP	42" CIP to Oldeander North Branch No. 17	90.00	144	25.00	194	290.38	302.08	11.70
Z4	FRE	M	6341382	2110720.2	M-03	0728+28	4'x3'RCBC	Private facility (equivalent to adjacent BNSF)	90.00	135	0.00	135	282.98	294.08	11.10
Z4	FRE	M	6341398	2109686.3	M-04	0736+35	15'x6'RCBC	Wristen Ditch	90.00	135	25.00	185	281.08	293.53	12.45
Z4	FRE	M	6341421	2108802	M-05	0747+46	4'x3' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	135	0.00	135	277.28	292.77	15.49
Z4	FRE	M	6341550	2104388	M-06	0791+63	5'x3' RCBC	Kohler Pipeline	91.00	140	0.00	140	278.84	289.76	10.91
Z4	FRE	M	6342941	2093788.9	M-07	0898+66	36" DBL RCP	Unnamed Ditch?	102.00	151	25.00	201	279.26	285.8	6.54
Z4	FRE	M	6343205	2092354.4	M-08	0913+25	5'x6' RCBC	Culvert Equivalent to Adjacent BNSF Facility	90.00	200	0.00	200	273.9	285.52	11.62
Z4	FRE	M	6343884	2088971.1	M-09	0947+76	15'x6' RCBC	Harlan Stevens Ditch	116.00	134	25.00	184	267.39	284.95	17.56
Z4	FRE	M	6343989	2088535.1	M-10	0952+25	4'x3' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	134	0.00	134	274.14	285.23	11.08
Z4	FRE	M	6344449	2086816.8	M-11	0970+03	12'x8' RCBC	Davis Ditch	97.00	136	25.00	186	274.5	287.5	13.00
Z4	FRE	M	6344456	2086794.5	M-12	0970+27	8'x4' RCBC	Culvert Equivalent to Adjacent BNSF Facility	97.00	136	0.00	136	278.17	287.53	9.36
Z4	FRE	M	6345225	2084203.4	M-13	0997+30	5'x4' RCBC	Culvert Equivalent to Adjacent BNSF Facility	90.00	136	0.00	136	277.99	290.85	12.85
Z4	FRE	M	6345673	2082702.9	M-14	1012+95	9'x7' DBL RCBC	Elkhorn Ditch	90.00	136	25.00	186	270.86	288.95	18.08
Z4	FRE	M	6347052	2083185.9	M-15	approx 1008+00	9'x7' DBL RCBC	Elkhorn Ditch under road	N/A	100	25.00	150	N/A	N/A	N/A
Z4	FRE	M	6346635	2083008.7	M-16	approx 1010+00	9'x7' DBL RCBC	Elkhorn Ditch under road	N/A	40	25.00	90	N/A	N/A	N/A
Z4	FRE	M	6345168	2082689.4	M-17	approx 1013+00	9'x7' DBL RCBC	Elkhorn Ditch under road	N/A	376	25.00	426	N/A	N/A	N/A
Z4	FRE	H	6347937	2075790	H-01	1085+63	48" DBL RCP	Pipeline (equivalent to adjacent BNSF)	108.00	283	0	283	264.85	282.98	18.14
Z4	FRE	H	6354408	2064117.4	H-02	1220+27	5'x3' RCBC	Periodic hydraulic relief	90.00	203	0	203	260.52	271.06	10.5
Z4	FRE	H	6373468	2051157.6	H-03	1445+97	15'x15' TRPL RCBC	Crosscut Waste	90.00	120	25	170	261.34	277.41	16.07
Z4	FRE	H	6376148	2048851.4	H-04	1487+18	345' BRIDGE	Cole Slough	103.00	80	0	170	257.62	298.33	40.72
Z4	FRE	H	6378548	2046345.5	H-05	1521+88	700' BRIDGE	Dutch John Cut	83.00	80	0	425	268.38	300.55	32.16
Z4	KIN	H	6382136	2041456.2	H-06	1582+59	636' BRIDGE	Kings River	90.00	80	0	400	262.22	301.31	39.09
Z4	KIN	H	6382768	2040386.9	H-07	1595+00	viaduct, 25' span	Riverside Ditch	74.00	80	0	80	268.38	297.22	28.85
Z4	KIN	H	6383108	2039774.8	H-08	1601+00	5'x3' RCBC	Periodic hydraulic relief	90.00	100	0	100	268.48	293.055	24
Z4	KIN	H	6383508	2039014.4	H-09	1610+59	10'x5' RCBC	Unnamed Ditch	117.00	100	0	100	268.58	288.89	20.31
Z4	KIN	H	6383795	2038441.8	H-10	1617+00	5'x3' RCBC	Periodic hydraulic relief	90.00	100	0	100	266.095	283.84	17.
Z4	KIN	H	6386537	2030795.4	H-11	1698+40	15'x15' TRPL RCBC	Peoples Ditch	64.00	127	25	177	263.61	278.79	15.18
Z4	KIN	H	6385310	2029759.6	H-12	approx 1710+00	13'x9' DBL RCBC	Culvert under Excelsior Ave, People's Ditch	N/A	220	25	270	N/A	N/A	N/A
Z4	KIN	H	6389539	2018997.3	H-13	approx 1818+00	12'x7' DBL RCBC	Culvert under systems road, East Branch Peoples Ditch	N/A	150	25	200	N/A	N/A	N/A
Z4	KIN	H	6387497	2017452.2	H-14	1832+59	9'x7' DBL RCBC	East Branch Peoples Ditch	90.00	122	25	172	258.74	271.49	12.74
Z4	KIN	H	6387409	2000448.9	H-15	2002+64	8'x5' DBL RCBC	Settlers Canal West Branch	90.00	82	25	132	240.8	273.02	32.22
Z4	KIN	H	6387407	2000175	H-16	2005+38	15' x14' TRPL RCBC	Lakeside Ditch	90.00	82	25	132	239.13	270.03	30.90
Z4	KIN	H	6387285	1997791.8	H-17	approx 2029+00	12'x9' DBL RCBC	Culvert under Hanford Armona Ave, Lakeside Ditch - Settlers Branch	N/A	368	25	418	N/A	N/A	N/A

ZONE	COUNTY	HST ALIGN	Easting	Northing	Point ID	Sta #	Proposed Facility (internal width x internal height)	Purpose/ Existing Feature Crossed	Crossing angle (clockwise from North)	ROW width (ft)	additional dist. either side (ft)	Total length of channel spanned by culvert (ft)	Existing Elevation (of INV)	Proposed Elevation (of track)	Distance to Top of Rail (ft)
Z4	KIN	H	6387349	1989035	H-18	2116+71	36" RCP	Unnamed Ditch	90.00	120	0	120	234.34	244.14	9.79
Z4	KIN	H	6387345	1988341	H-19	2123+71	36" RCP	Unnamed Ditch	90.00	120	0	120	232.19	243.61	11.42
Z4	KIN	H	6387211	1987027.5	H-20	approx 2137+00	8'x9' DBL RCBC	Culvert under Iona Ave, Lakeside Ditch - Settlers Branch	N/A	472	25	522	N/A	N/A	N/A
Z4	FRE	HW	6347937	2075790	HW-01	1085+63	48" DBLRCP	Unknown (equivalent to adjacent BNSF)	108.00	281	0	281	264.85	282.98	18.14
Z4	FRE	HW	6355275	2051239.2	HW-02	1342+47	12'x5' RCBC	Liberty Ditch	97.00	120	25	170	246.8	260.64	13.84
Z4	FRE	HW	6355360	2050480	HW-03	1350+00.02	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	250.34	260.5	10.16
Z4	FRE	HW	6355428	2049783.4	HW-04	1356+99.93	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	250.07	260.37	10.31
Z4	FRE	HW	6355491	2048985.6	HW-05	1365+00.23	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	250.63	260.23	9.60
Z4	FRE	HW	6355550	2047987.5	HW-06	1375+00.06	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	249.62	261.53	11.91
Z4	FRE	HW	6355587	2046988.3	HW-07	1384+99.92	5'x3' RCBC	Periodic hydraulic relief	90.00	140	0	140	249.68	266.98	17.30
Z4	FRE	HW	6355595	2046290.2	HW-08	1391+98.12	5'x3' RCBC	Periodic hydraulic relief	90.00	160	0	160	249.27	271.68	22.41
Z4	FRE	HW	6355595	2045389.3	HW-09	1400+99.17	5'x3' RCBC	Periodic hydraulic relief	90.00	180	0	180	249.96	277.75	27.79
Z4	FRE	HW	6355584	2043999.9	HW-10	1415+07	viaduct, 107' span	Murphy Slough	103.00	80	0	80	238.17	287.11	48.94
Z4	FRE	HW	6355533	2039842	HW-11	1456+47	viaduct, 40' span	A Ditch	117.00	80	0	80	257.66	297.1	39.44
Z4	FRE	HW	6355531	2039726.6	HW-12	1457+62	viaduct, 30' span	Grant Canal	117.00	80	0	80	248.85	297.09	48.24
Z4	FRE	HW	6355530	2039642.1	HW-13	1458+46	viaduct, 3' span	Unnamed Ditch	118.00	80	0	80	253.04	297.08	44.03
Z4	FRE/KIN	HW	6355517	2038631.5	HW-14	1468+57	viaduct, 229' span	Kings River	104.00	80	0	80	241.05	296.75	55.70
Z4	KIN	HW	6355481	2035689	HW-15	1498+00.14	5'x3' RCBC	Periodic hydraulic relief	90.00	176	0	176	252.56	275.41	22.85
Z4	KIN	HW	6355464	2034303.3	HW-16	1511+80	15'x15' 4xRCBC	Riverside Ditch	89.00	120	25	170	246.81	262.97	16.16
Z4	KIN	HW	6355373	2026941.6	HW-17	1585+50	10'x8' DBL RCBC	Hardwick Ditch	90.00	120	25	170	243.42	257.54	14.12
Z4	KIN	HW	6355309	2021824.7	HW-18	1636+65	6'x4' DBL RCBC	Bakker Ditch	90.00	120	25	170	239.3	251.36	12.06
Z4	KIN	HW	6356653	2013858.6	HW-19	approx 1716+50	6'x4' DBL RCBC	Culvert under Fargo Ave, Bakker Ditch	N/A	342	25	392	N/A	N/A	N/A
Z4	KIN	HW	6355820	2013580.3	HW-20	1719+45	15'x15' TRPL RCBC	West Main Last Chance Ditch	90.00	128	25	178	233.39	246.9	13.51
Z4	KIN	HW	6356364	2011206.4	HW-21	1743+81	8'x6' DBL RCBC	Blowers Ditch	105.00	128	25	178	233.01	247.19	14.18
Z4	KIN	HW	6356617	2003282.1	HW-22	approx 1825	16'x12' DBL RCBC	Culvert West Lacey Blvd, East Main Last Chance Ditch	N/A	136	25	186	N/A	N/A	N/A
Z4	KIN	HW	6358436	1999690	HW-23	approx 1861+00	16'x12' DBL RCBC	East Main Last Chance Ditch SJVR, 140 on SJVR	N/A	16	25	66	N/A	N/A	N/A
Z4	KIN	HW	6358953	1998792.3	HW-24	approx 1870+00	16'x12' DBL RCBC	Culvert under 198. East Main Last Chance Ditch	N/A	751	25	801	N/A	N/A	N/A
Z4	KIN	HW	6360381	1994545.1	HW-25	1914+70	15'x15' TRPL RCBC	Mussel slough	90.00	120	0	120	220.51	234.5	13.99
Z4	KIN	HW	6363341	1987111	HW-26	approx1992+00	15'x10' DBL RCBC	Culvert under Iona Ave, New Deal Ditch	N/A	228	0	230	N/A	N/A	N/A
Z4	FRE	HW2	6347937	2075790	HW2-01	1085+63	48" DBL RCP	Unknown (equivalent to adjacent BNSF)	108.00	281	0	281	264.85	282.98	18.14
Z4	FRE	HW2	6355275	2051239.2	HW2-02	1342+35	12'x5' RCBC	Liberty Ditch	97.00	120	25	170	246.8	260.64	13.84
Z4	FRE	HW2	6355360	2050480	HW2-03	1350+00.02	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	250.34	260.5	10.16
Z4	FRE	HW2	6355428	2049783.4	HW2-04	1356+99.93	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	250.07	260.37	10.31
Z4	FRE	HW2	6355491	2048985.6	HW2-05	1365+00.23	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	250.63	260.23	9.60
Z4	FRE	HW2	6355550	2047987.5	HW2-06	1375+00.06	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	249.62	261.53	11.91
Z4	FRE	HW2	6355587	2046988.3	HW2-07	1384+99.92	5'x3' RCBC	Periodic hydraulic relief	90.00	140	0	140	249.68	266.98	17.30
Z4	FRE	HW2	6355595	2046290.2	HW2-08	1391+98.12	5'x3' RCBC	Periodic hydraulic relief	90.00	160	0	160	249.27	271.68	22.41
Z4	FRE	HW2	6355595	2045389.3	HW2-09	1400+99.17	5'x3' RCBC	Periodic hydraulic relief	90.00	180	0	180	249.96	277.75	27.79
Z4	FRE	HW2	6355584	2043999.9	HW2-10	1414+89	viaduct, 107' span	Murphy Slough	103.00	80	0	80	238.17	287.11	48.94
Z4	FRE	HW2	6355533	2039842	HW2-11	1456+47	viaduct, 40' span	A Ditch	117.00	80	0	80	257.66	297.1	39.44
Z4	FRE	HW2	6355531	2039726.6	HW2-12	1457+62	viaduct, 30' span	Grant Canal	117.00	80	0	80	248.85	297.09	48.24
Z4	FRE	HW2	6355530	2039642.1	HW2-13	1458+46	viaduct, 3' span	Unnamed Ditch	118.00	80	25	130	253.04	297.08	44.03
Z4	FRE/KIN	HW2	6355517	2038631.5	HW2-14	1468+57	viaduct, 229' span	Kings River	104.00	80	0	80	241.05	296.75	55.70
Z4	KIN	HW2	6355481	2035689	HW2-15	1498+00	5'x3' RCBC	Periodic hydraulic relief	90.00	176	0	176	252.62	275.1	22.48
Z4	KIN	HW2	6355464	2034303.3	HW2-16	1511+80	15'x15' 4xRCBC	Riverside Ditch	89.00	120	25	170	246.81	262.97	16.16
Z4	KIN	HW2	6355373	2026941.6	HW2-17	1585+50	10'x8' DBL RCBC	Hardwick Ditch	123.00	120	25	170	243.42	257.62	14.20
Z4	KIN	HW2	6355309	2021824.7	HW2-18	1636+65	6'x4' DBL RCBC	Bakker Ditch	90.00	120	25	170	239.3	251.26	11.96

HYDRAULIC CROSSING POINTS

ZONE	COUNTY	HST ALIGN	Easting	Northing	Point ID	Sta #	Proposed Facility (internal width x internal height)	Purpose/ Existing Feature Crossed	Crossing angle (clockwise from North)	ROW width (ft)	additional dist. either side (ft)	Total length of channel spanned by culvert (ft)	Existing Elevation (of INV)	Proposed Elevation (of track)	Distance to Top of Rail (ft)
Z4	KIN	HW2	6356653	2013858.6	HW2-19	approx 1716+50	6'x4' DBL RCBC	Culvert under Fargo Ave, Bakker Ditch	N/A	342	25	392	N/A	N/A	N/A
Z4	KIN	HW2	6355630	2013467	HW2-20	1720+34	15'x15' TRPL RCBC	West Main Last Chance Ditch	84.00	128	25	178	235.64	246.53	10.88
Z4	KIN	HW2	6355967	2011240.5	HW2-21	1742+92	8'x6' DBL RCBC	Blowers Ditch	101.00	128	25	178	233.01	246.73	13.72
Z4	KIN	HW2	6356902	2003235.8	HW2-22	approx 1825	16'x12' DBL RCBC	Culvert under West Lacey Blvd. East Main Last Chance Ditch	N/A	136	25	186	N/A	N/A	N/A
Z4	KIN	HW2	6358087	1999919.9	HW2-23	approx 1858+50	16'x12' DBL RCBC	Culvert under 13th Ave. East Main Last Chance Ditch	N/A	94	25	144	N/A	N/A	N/A
Z4	KIN	HW2	6358623	1999162.6	HW2-24	approx 1866+50	16'x12' DBL RCBC	Culvert under SJVR. East Main Last Chance Ditch	N/A	108	25	158	N/A	N/A	N/A
Z4	KIN	HW2	6358691	1998901.6	HW2-25	approx 1869+50	16'x12' DBL RCBC	Culvert under 13th Road. East Main Last Chance Ditch	N/A	109	25	159	N/A	N/A	N/A
Z4	KIN	HW2	6358751	1998622.1	HW2-26	approx 1872	16'x12' DBL RCBC	Culvert under 198. East Main Last Chance Ditch	N/A	223	25	273	N/A	N/A	N/A
Z4	KIN	HW2	6358665	1997976.6	HW2-27	approx 1880	16'x12' DBL RCBC	Culvert under Hanford Armona Road. East Main Last Chance Ditch	N/A	66	25	116	N/A	N/A	N/A
Z4	KIN	HW2	6360191	1994254.1	HW2-28	1917+50	15'x15' TRPL RCBC	Mussel slough	90.00	120	25.00	170	222.73	232.46	9.74
Z4	KIN	HW2	6359318	1992376.7	HW2-29	approx 1937+00	16'x12' DBL RCBC	Culvert under Houseton Ave, Unnamed Canal	N/A	92	25.00	142	N/A	N/A	N/A
Z4	KIN	K1	6363321	1982536.6	K1-01	2039+27.05	11'x15' DBL RCBC	People's Ditch/New Deal Ditch	90.00	127	25	177	204.26	228.11	23.85
Z4	KIN	K1	6366738	1976533.3	K1-02	approx 2102+00	13'x16' 4x RCBC	Culvert under Jackson Ave, Lakeside ditch	N/A	50	0	50	N/A	N/A	N/A
Z4	KIN	K1	6365829	1974608.3	K1-03	2122+59.81	15'x6' RCBC	Lakeside Ditch	90.00	141	25	191	212.46	225.76	13.29
Z4	KIN	K1	6367517	1971246.4	K1-04	2160+21.96	5'x7' DBL RCBC	Unnamed Ditch	114.00	151	25	201	203.24	220.64	17.40
Z4	KIN	K1	6368239	1969825.6	K1-05	2176+15.71	6'x4' DBL RCBC	Unnamed Ditch	114.00	162	25	212	203.79	218.47	14.67
Z4	KIN	K1	6368668	1968981.2	K1-06	2185+62.96	6'x3' RCBC	Unnamed Ditch	90.00	168	25	218	205.12	218.72	13.60
Z4	KIN	K1	6369535	1967277.1	K1-07	2204+76.42	5'x6' DBL RCBC	Unnamed Ditch	116.00	183	25	233	201.92	228.14	26.23
Z4	KIN	K1	6371038	1964391.6	K1-08	2237+28.54	35' span, on viaduct	Melga Canal	28.00	100	25	150	198.1	244.28	46.18
Z4	KIN	K1	6373802	1960478.6	K1-09	approx 2280+00	6'x12' RCBC	Culvert under road	N/A	240	25.00	290	N/A	N/A	N/A
Z4	KIN	K1	6373887	1959409.2	K1-10	2294+68.07	6'x8' DBL RCBC	Lakeside Ditch - Guernsey Branch	90.00	174	25	224	201.2	213.42	12.22
Z4	KIN	K1	6377311	1953555.4	K1-11	2362+49.66	15'x11' DBL RCBC	Hamar Ditch	90.00	155	25	205	196.79	209.65	12.85
Z4	KIN	K1	6377949	1952465.5	K1-12	2375+12.81	10'x 14' DBL RCBC	Unnamed Ditch	90.00	163	25	213	196.68	214.71	18.03
Z4	KIN	K1	6378345	1951784.3	K1-13	2383+00.56	5'x3' RCBC	Periodic hydraulic relief	90.00	169	0	169	196.59	220	23.40
Z4	KIN	K1	6378800	1951011.5	K1-14	2391+97.49	5'x3' RCBC	Periodic hydraulic relief	90.00	182	0	182	196.32	225.48	29.16
Z4	KIN	K1	6379159	1950403.5	K1-15	2399+03.28	5'x3' RCBC	Periodic hydraulic relief	90.00	189	0	100	196.49	227.68	31.19
Z4	KIN	K1	6379868	1949184.8	K1-16	2413+13.55	13'x13' TRPL RCBC	McCann no.1 Canal (Salvador Ditch)	90.00	100	25	130	195.33	228.01	32.68
Z4	KIN	K1	6381826	1945895.2	K1-17	2451+41.54	320' BRIDGE	Cross Creek	48.00	80	0	57	188.71	228.01	39.29
Z4	KIN	K1	6384277	1942828.7	K1-18	approx 2489+00	7'x15' RCBC	culvert under systems road, McCann No. 2 Ditch	N/A	57	25	130	N/A	N/A	N/A
Z4	KIN	K1	6384230	1942022.3	K1-19	2497+00	22' span, on viaduct	McCann no. 2 Ditch	32.00	80	25	130	192.98	227.99	35.02
Z4	KIN	K1	6384891	1940927.6	K1-20	2509+78.99	5'x3' RCBC	Periodic hydraulic relief	90.00	100	0.00	100	199.05	224.76	25.71
Z4	KIN	K1	6385311	1940228.8	K1-21	2517+94.31	10'x3' RCBC	Wildlife Crossing Structure	90.00	100	0	100	199.5	221.07	21.57
Z4	KIN	K1	6385763	1939452.6	K1-22	2526+92.46	5'x3' RCBC	Periodic hydraulic relief	90.00	100	0	100	199.46	217	17.54
Z4	KIN	K1	6386172	1938756.8	K1-23	2535+00.48	10'x3' RCBC	Wildlife Crossing Structure	90.00	100	0	100	194.17	213.34	19.17
Z4	KIN	K1	6386715	1937827.8	K1-24	2545+75.52	13'x16' 4x RCBC	West Branch Lakeland Canal	90.00	100	25	150	193.57	208.47	14.90
Z4	KIN	K1	6387182	1937030.6	K1-25	2554+99.73	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	195.33	205.86	10.54
Z4	KIN	K1	6387663	1936207.3	K1-26	2564+52.96	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	195.58	206.34	10.76
Z4	KIN	K2	6363318	1982548.4	K2-01	2039+03	15'x11' DBL RCBC	People's Ditch/New Deal Ditch	83.00	120	25	170	204.08	227.36	23.27
Z4	KIN	K2	6365410	1973923.5	K2-02	2127+78	12'x5' RCBC	Unnamed Ditch	103.00	120	25	170	210.39	224.37	13.98
Z4	KIN	K2	6365818	1972244.7	K2-03	2145+18	10'x7' DBL RCBC	Lakeside Ditch	90.00	128	25	178	208.66	221.86	13.20
Z4	KIN	K2	6366059	1971252.1	K2-04	2155+11	8'x6' DBL RCBC	Unnamed Ditch	103.00	124	25	174	204.47	220.15	15.69
Z4	KIN	K2	6366435	1969838.7	K2-05	2169+89	10'x4' RCBC	Unnamed Ditch	106.00	124	25	174	204.03	217.71	13.68
Z4	KIN	K2	6367231	1965974.4	K2-06	approx 2210	12'x5' RCBC	Culvert under Kent Ave, Lakeside Ditch - Alcorn Branch	N/A	60	25	110	N/A	N/A	N/A
Z4	KIN	K2	6370611	1962041.4	K2-07	225890	7'x5' DBL RCBC	Unnamed Ditch	90.00	120	25	170	196.55	211.08	14.53
Z4	KIN	K2	6371224	1961313	K2-08	2268+50	15'x12' TRPL RCBC	Melga Canal	90.00	120	25	170	195.44	211.08	15.64
Z4	KIN	K2	6373438	1958679.6	K2-09	2302+90	10'x4' RCBC	Unnamed Ditch	90.00	120	25	170	198.21	211.1	12.89
Z4	KIN	K2	6373886	1958112.8	K2-10	2308+46	8'x6' DBL RCBC	Lakeside Ditch - Guernsey Branch	90.00	120	25	170	198.21	211.1	12.89

ZONE	COUNTY	HST ALIGN	Easting	Northing	Point ID	Sta #	Proposed Facility (internal width x internal height)	Purpose/ Existing Feature Crossed	Crossing angle (clockwise from North)	ROW width (ft)	additional dist. either side (ft)	Total length of channel spanned by culvert (ft)	Existing Elevation (of INV)	Proposed Elevation (of track)	Distance to Top of Rail (ft)
Z4	KIN	K2	6377087	1953423.8	K2-11	2366+92	15'x10 DBL RCBC	Hamar Ditch	90.00	195	25	245	197.42	216.41	18.99
Z4	KIN	K2	6377727	1952336.1	K2-12	2379+53	13'x12' TRPL RCBC	Unnamed Ditch	90.00	180	25	230	197.17	219.3	22.12
Z4	KIN	K2	6378154	1951604.8	K2-13	2388+00.31	5'x3' RCBC	Periodic hydraulic relief	90.00	180	0	180	197.17	221.24	24.07
Z4	KIN	K2	6378609	1950829.1	K2-14	2396+99.71	5'x3' RCBC	Periodic hydraulic relief	90.00	180	0	180	196.69	223.29	26.60
Z4	KIN	K2	6379647	1949054.7	K2-15	2417+55	13'x13' TRPL RCBC	Unnamed Ditch	90.00	125	25	175	197.6	226.26	28.66
Z4	KIN	K2	6381756	1945452	K2-16	2459+30	320' BRIDGE	Cross Creek	46.00	124	0	124	188.7	226.26	37.56
Z4	KIN	K2	6384176	1941317.4	K2-17	2507+20	12'x8' DBL RCBC	McCann no. 2 Ditch	90.00	116	25	166	190.98	225.89	34
Z4	KIN	K2	6386434	1937458.6	K2-18	2551+93	15'x16' TRPL RCBC	West Branch Lakeland Canal	73.00	115	0	115	193.26	225.52	32.26
Z4	KIN	K2	6386878	1936699.2	K2-19	2560+70.90	5'x3' RCBC	Periodic hydraulic relief	90.00	135	0	135	195.36	221.95	26.59
Z4	KIN	K2	6387096	1936329.3	K2-20	2565+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	135	0	135	196.12	219.63	23.51
Z4	KIN	K2	6387383	1935837.3	K2-21	2570+73.37	5'x3' RCBC	Periodic hydraulic relief	90.00	135	0	135	195.54	216.55	21.01
Z4	KIN	K2	6387787	1935146.6	K2-22	2578+70	10'x3' RCBC	Wildlife Crossing Structure	90.00	135	0	135	194.57	212.97	18.40
Z4	KIN	K2	6387853	1935034.8	K2-23	2579+99.99	5'x3' RCBC	Periodic hydraulic relief	90.00	135	0	135	195.56	212.56	16.99
Z4	KIN	K2	6388582	1933789.5	K2-24	2594+44	15'x15' TRPL RCBC	Bean Ditch	118.00	186	25	236	196.05	209.57	13.52
Z4	KIN	K2	6388971	1934344.6	K2-25	approx 2590+00	15'x20' 4xRCBC	Culvert under Nevada Ave, Sweet Canal	N/A	440	25	490	N/A	N/A	N/A
Z4	KIN	K2	6387036	1933799.6	K2-26	approx 2594	15'x11' DBL RCBC	Culvert under Nevada Ave access road, Bean Ditch	N/A	130	25	180	N/A	N/A	N/A
Z4	KIN	K2	6387423	1933734.1	K2-27	approx 2595	15'x11' DBL RCBC	Culvert under Nevada Ave access road, Unnamed Ditch	N/A	100	25	150	N/A	N/A	N/A
Z4	KIN	K3	6387327	1984373.1	K3-01	2092+73	5'x4' DBL RCBC	Unnamed Ditch	90.00	124	25	174	226.76	240.6	13.84
Z4	KIN	K3	6388968	1981734.4	K3-02	approx 2120+00	8'x11' DBL RCBC	Culvert under Idaho Ave, Lakeside Ditch - Eucalpyptus Branch	N/A	61	25	111	N/A	N/A	N/A
Z4	KIN	K3	6387305	1981461	K3-03	2121+85	10'x8' DBL RCBC	Lakeside Ditch - Eucalyptus Branch	90.00	128	25	178	226.43	238.39	11.96
Z4	KIN	K3	6387175	1979106.3	K3-04	2145+44	8'x4'RCBC	Unnamed ditch	90.00	137	25	187	225.5	236.6	11.09
Z4	KIN	K3	6388558	1976448.6	K3-05	approx 2173+00	15'x11' DBL RCBC	Culvert under Jackson Ave, Melga canal	N/A	52	25	102	N/A	N/A	N/A
Z4	KIN	K3	6386475	1975092.3	K3-06	2186+19	15'x11' DBL RCBC	Melga Canal	77.00	144	25	194	211.91	233.68	21.77
Z4	KIN	K3	6385189	1971141.9	K3-07	2227+81	36" DBL RCP	Burr Pipeline	67.00	134	0	134	217.17	229.93	12.77
Z4	KIN	K3	6381864	1960199.4	K3-08	approx 22345+00	13'x6' RCBC	Culvert under Kansas Ave, West Fork of East Branch, Lakeside Ditch	N/A	500	25	550	N/A	N/A	N/A
Z4	KIN	K3	6381022	1959159.4	K3-09	2355+21	8'x4'RCBC	Unnamed Ditch	83.00	129	25	179	202.94	216.24	13.30
Z4	KIN	K3	6380826	1957495.9	K3-10	2371+96	36" DBL RCP	Batti Basin	86.00	129	25	179	198.68	214.44	15.76
Z4	KIN	K3	6380811	1957314.3	K3-11	2373+78	36" DBL RCP	Batti Basin	86.00	129	25	179	198.68	214.24	15.56
Z4	KIN	K3	6380717	1955169.4	K3-12	2395+26	8'x7' DBL RCBC	Wreden Ditch (Salvador Ditch)	91.00	120	25	170	194.94	211.94	16.99
Z4	KIN	K3	6380820	1952561.9	K3-13	2421+36	9'x7' DBL RCBC	Unnamed Canal	96.00	164	25	214	195	210.22	15.22
Z4	KIN	K3	6380884	1951900.9	K3-14	2428+00	5'x3' RCBC	Periodic hydraulic relief	90.00	144	0	144	198	212.56	14.55
Z4	KIN	K3	6380961	1951257.4	K3-15	2434+48	10'x3' RCRC	Wildlife Crossing Structure	90.00	144	0	144	197.12	216.11	18.99
Z4	KIN	K3	6381054	1950612.4	K3-16	2440+00	5'x3' RCBC	Periodic hydraulic relief	90.00	144	0	144	197.12	219.96	22.84
Z4	KIN	K3	6381166	1949939.7	K3-17	2447+82	14'x6' RCBC	Unnamed Canal	101.00	124	25	174	198.85	223.31	24.46
Z4	KIN	K3	6381179	1949867.3	K3-18	2448+47	11'x8' DBL RCBC	McCann no.1 Canal (Salvador Ditch)	101.00	124	25	174	198.17	223.57	25.40
Z4	KIN	K3	6382056	1946340.7	K3-19	2484+92	290' BRIDGE	Cross Creek	53.00	80	0	80	189.25	229.55	40.30
Z4	KIN	K3	6383404	1942888.8	K3-20	2522+00	5'x3' RCBC	Periodic hydraulic relief	90.00	197	0	197	198.54	233.88	35.34
Z4	KIN	K3	6384277	1942828.7	K3-21	approx 2523+00	15'x7' RCBC	culvert under systems road	N/A	57	0	57	N/A	N/A	N/A
Z4	KIN	K3	6384193	1941325.3	K3-22	2539+50	12'x8' DBL RCBC	McCann no. 2 Ditch	90.00	120	25	170	194.09	231.6	37.51
Z4	KIN	K3	6386421	1937479.4	K3-23	2584+20	16'x15' TRPL RCBC	West Branch Lakeland Canal	90.00	114	25	164	193.26	225.71	32.46
Z4	KIN	K3	6386878	1936699.2	K3-24	2593+00	5'x3' RCBC	Periodic hydraulic relief	90.00	180	0	180	195.37	222.79	27.42
Z4	KIN	K3	6387383	1935837.3	K3-25	2603+00	5'x3' RCBC	Periodic hydraulic relief	90.00	118	0	118	195.57	217.48	21.91
Z4	KIN	K3	6387787	1935146.6	K3-26	2611+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	118	0	118	194.57	213.52	18.95
Z4	KIN	K3	6388975	1934327.3	K3-27	approx 2623+00	15'x20' 4xRCBC	Culvert under Nevada Ave, Sweet Canal	N/A	310	25	360	N/A	N/A	N/A
Z4	KIN	K3	6387036	1933808.9	K3-28	approx 2626+50	15'x11' DBL RCBC	Culvert under Nevada Ave access road, Bean Ditch	N/A	166	25	216	N/A	N/A	N/A
Z4	KIN	K3	6387423	1933733.7	K3-29	approx 2626+50	15'x11' DBL RCBC	Culvert under Nevada Ave access road, Unnamed Canal	N/A	55	25	105	N/A	N/A	N/A
Z4	KIN	K3	6388576	1933797	K3-30	2626+78	15'x15' TRPL RCBC	Bean Ditch	90.00	136	0	136	196.05	209.59	13.54

ZONE	COUNTY	HST ALIGN	Easting	Northing	Point ID	Sta #	Proposed Facility (internal width x internal height)	Purpose/ Existing Feature Crossed	Crossing angle (clockwise from North)	ROW width (ft)	additional dist. either side (ft)	Total length of channel spanned by culvert (ft)	Existing Elevation (of INV)	Proposed Elevation (of track)	Distance to Top of Rail (ft)
Z4	KIN	K4	6387327	1984373.1	K4-01	2093+71.98	5'x4' DBL RCBC	Unnamed Ditch	90.00	129	25	179	227	240.6	13.60
Z4	KIN	K4	6388968	1981734.2	K4-02	approx 2120+00	8'x11' DBL RCBC	Culvert under Idaho Ave, Lakeside Ditch - Eucalpyptus Branch	N/A	78	0	78	N/A	N/A	N/A
Z4	KIN	K4	6387283	1981460.6	K4-03	2122+84.97	10'x8' DBL RCBC	Lakeside Ditch - Eucalyptus Branch	88.00	130	25	180	226.3	238.39	12.09
Z4	KIN	K4	6387152	1979125.8	K4-04	approx 2146+00	Shortened ditch	Unnamed ditch	90.00	130	0	N/A	N/A	N/A	N/A
Z4	KIN	K4	6388558	1976448.6	K4-05	approx 2173+00	15'x11' DBL RCBC	Culvert under Jackson Ave, Melga canal	N/A	53	25	103	N/A	N/A	N/A
Z4	KIN	K4	6386324	1975098.9	K4-06	2187+30.53	15'x11' DBL RCBC	Melga Canal	77.00	129	25	179	211.66	232.29	20.63
Z4	KIN	K4	6384998	1971145.4	K4-07	2229+03.78	18" Pipeline	Burr Pipeline	67.00	128	25	178	214.73	228.54	13.81
Z4	KIN	K4	6381864	1960199.4	K4-08	approx 2343+00	13'x6' RCBC	Culvert under Kansas Ave, West Fork of East Branch, Lakeside Ditch	N/A	500	25	550	N/A	N/A	N/A
Z4	KIN	K4	6381285	1959150	K4-09	2355+17.97	8'x4'RCBC	Unnamed Ditch	83.00	146	25	196	203.56	217.98	14.42
Z4	KIN	K4	6381142	1957474.3	K4-10	2371+99.95	36" DBL RCP	Batti Basin	86.00	138	25	188	198.68	216.57	17.89
Z4	KIN	K4	6381134	1957329.9	K4-11	2373+44.58	36" DBL RCP	Batti Basin	86.00	138	25	188	198.68	216.45	17.77
Z4	KIN	K4	6381097	1955168.4	K4-12	2395+06.87	8'x7' DBL RCBC	Wreden Ditch (Salvador Ditch)	91.00	194	25	244	194.94	214.64	19.70
Z4	KIN	K4	6381259	1952520.5	K4-13	2421+60.60	9'x7' DBL RCBC	Unnamed Canal	96.00	177	25	227	193.99	212.46	18.47
Z4	KIN	K4	6381326	1951885	K4-14	2427+99.43	5'x3' RCBC	Periodic hydraulic relief	90.00	186	25	216	197.99	213.1	15.11
Z4	KIN	K4	6381429	1951192.1	K4-15	2434+99.82	10'x3' RCBC	Wildlife Crossing Structure	90.00	192	0	166	196.85	215.73	18.88
Z4	KIN	K4	6381525	1950598.2	K4-16	2441+01.42	5'x3' RCBC	Periodic hydraulic relief	90.00	203	0	203	197.34	219.32	21.99
Z4	KIN	K4	6381643	1949943.8	K4-17	2447+66.50	14'x6' RCBC	Unnamed Canal	101.00	166	0	166	192.9	223.41	30.51
Z4	KIN	K4	6381657	1949868.2	K4-18	2448+43.39	11'x8' DBL RCBC	McCann no.1 Canal (Salvador Ditch)	101.00	166	25	216	191.76	223.89	32.13
Z4	KIN	K4	6382439	1946749.4	K4-19	2480+60.32	290' BRIDGE	Cross Creek	83.00	120	25	170	189.31	230	40.69
Z4	KIN	K4	6384277	1942828.7	K4-20	2523+00	7'x15' RCBC	culvert under systems road	N/A	94	0	94	N/A	N/A	N/A
Z4	KIN	K4	6384234	1942231.4	K4-21	2529+84.27	11'x7' DBL RCBC	McCann no. 2 Ditch	26.00	120	25	170	192.62	227.69	35.07
Z4	KIN	K4	6384966	1940839.1	K4-22	2544+99.93	5'x3' RCBC	Periodic hydraulic relief	90.00	80	0	80	198.5	221.14	22.64
Z4	KIN	K4	6385311	1940228.8	K4-23	2552+01.19	10'x3' RCBC	Wildlife Crossing Structure	90.00	80	0	80	199.5	218.1	18.60
Z4	KIN	K4	6385764	1939452.1	K4-24	2561+00.50	5'x3' RCBC	Periodic hydraulic relief	90.00	100	0	100	199.46	214.21	14.75
Z4	KIN	K4	6386219	1938676.6	K4-25	2569+99.40	10'x3' RCBC	Wildlife Crossing Structure	90.00	100	0	100	194.21	210.32	16.11
Z4	KIN	K4	6386715	1937827.8	K4-26	2579+82.40	13'x16' 4x RCBC	West Branch Lakeland Canal	90.00	100	25	150	193.57	206.35	12.78
Z4	KIN	K4	6387078	1937209.8	K4-27	2586+99.08	5'x3' RCBC	Periodic hydraulic relief	90.00	100	0	100	195.38	205.45	10.08
Z4	KIN	K4	6387431	1936603.6	K4-28	2594+00.70	5'x3' RCBC	Periodic hydraulic relief	90.00	100	0	100	195.44	205.98	10.54
Z4	KIN	K5	6363341	1987111	K5-1	approx 1992+00	15'x10' DBL RCBC	Culvert under Iona Ave and systems road	N/A	228	0	230	N/A	N/A	N/A
Z4	KIN	K5	6363360	1982551.4	K5-2	2039+20.16	15'x11' DBL RCBC	People's Ditch/New Deal Ditch	90.00	120	25.00	170	204.52	228	23.48
Z4	KIN	K5	6367153	1976533.3	K5-3	approx 2102+00	13'x16' 4x RCBC	Culvert under Jackson Ave, Lakeside ditch	N/A	114	0.00	114	N/A	N/A	N/A
Z4	KIN	K5	6365897	1975357.1	K5-4	2115+50.56	15'x6' RCBC	Lakeside Ditch	90.00	130	25.00	180	212.62	224.47	11.85
Z4	KIN	K5	6367632	1971246	K5-5	2160+13.23	5'x7' DBL RCBC	Unnamed Ditch	114.00	130	25.00	180	203.24	219.14	15.90
Z4	KIN	K5	6368544	1970737.2	K5-6	approx 2166+00	6'x4' RCBC	Culvert under road - Unnamed Ditch	N/A	56	0.00	56	N/A	N/A	N/A
Z4	KIN	K5	6368283	1969825.1	K5-7	2175+76.20	6'x4' DBL RCBC	Unnamed Ditch	114.00	130	25.00	180	203.74	217.17	13.44
Z4	KIN	K5	6368682	1968982.3	K5-8	2185+08.60	6'x3' RCBC	Unnamed Ditch	90.00	130	25.00	180	205.12	217.15	12.03
Z4	KIN	K5	6369519	1967277.1	K5-9	2204+08.10	5'x6' DBL RCBC	Unnamed Ditch	116.00	171	25.00	221	201.92	226.89	24.98
Z4	KIN	K5	6371053	1964351.8	K5-10	2237+11.66	15'x12' TRPL RCBC	Melga Canal	52.00	80	25.00	130	197.36	245.49	48.12
Z4	KIN	K5	6373802	1960478.6	K5-11	approx 2282+00	12'x6' RCBC	Culvert under Kansas Ave, Lakeside Ditch - Guernsey Branch	N/A	240	25.00	290	N/A	N/A	N/A
Z4	KIN	K5	6373887	1959409.2	K5-12	2294+09.28	6'x8' DBL RCBC	Lakeside Ditch - Guernsey Branch	90.00	145	25.00	195	201.2	211.38	10.18
34'	KIN	K5	6377667	1955155.6	K5-13	approx 2345+00	16'x10' DBL RCBC	Culvert under Lansing Ave, Wreden Ditch (Salvador Ditch)	N/A	34	0.00	34	N/A	N/A	N/A
Z4	KIN	K5	6377311	1953556.4	K5-14	2361+89.96	15'x11' DBL RCBC	Hamar Ditch	90.00	194	25	244	196.79	207.46	10.66
Z4	KIN	K5	6377949	1952465.5	K5-15	2374+54.01	10'x 14' DBL RCBC	Unnamed Ditch	90.00	201	25.00	251	196.68	213.82	17.13
Z4	KIN	K5	6378345	1951784.3	K5-16	2382+41.77	5'x3' RCBC	Periodic hydraulic relief	90.00	216	0	216	196.59	219.6	23.01
Z4	KIN	K5	6378800	1951011.5	K5-17	2391+38.70	5'x3' RCBC	Periodic hydraulic relief	90.00	229	0	229	196.32	225.4	29.08
Z4	KIN	K5	6379159	1950403.5	K5-18	2398+44.49	5'x3' RCBC	Periodic hydraulic relief	90.00	241	0	241	196.49	227.67	31.18
Z4	KIN	K5	6379869	1949183.5	K5-19	2412+54	13'x13' TRPL RCBC	McCann No. 1 Canal (salvador Ditch)	90.00	118	25.00	168	195.27	228.01	32.73
Z4	KIN	K5	6381807	1945834.7	K5-20	2451+24.29	320' BRIDGE	Cross Creek	43.00	118	25.00	168	188.71	228.01	39.29

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Z4	KIN	K5	6384277	1942828.7	K5-21	approx 2488+00	15'x7' RCBC	culvert under systems road	N/A	46	0	46	N/A	N/A	N/A
Z4	KIN	K5	6384230	1942022.5	K5-22	2494+99.79	11'x7' DBL RCBC	McCann no. 2 Ditch	90.00	80	25.00	130	194.78	228.01	33.22
Z4	KIN	K5	6384880	1940945	K5-23	2508+99.62	5'x3' RCBC	Periodic hydraulic relief	90.00	100	0.00	100	199.26	224.85	25.59
Z4	KIN	K5	6385312	1940229.3	K5-24	2517+35.42	10'x3' RCRC	Wildlife Crossing Structure	90.00	100	0	100	199.5	221.06	21.56
Z4	KIN	K5	6385763	1939452.6	K5-25	2526+34.82	5'x3' RCBC	Periodic hydraulic relief	90.00	100	0	100	199.46	216.99	17.53
Z4	KIN	K5	6386172	1938756.5	K5-26	2534+42.48	10'x3' RCRC	Wildlife Crossing Structure	90.00	100	0	100	194.17	213.33	19.16
Z4	KIN	K5	6386716	1937827.4	K5-27	2545+16.66	13'x16' 4x RCBC	West Branch Lakeland Canal	90.00	100	25	150	193.57	208.46	14.89
Z4	KIN	K5	6387182	1937030.3	K5-28	2554+40.94	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	195.33	205.86	10.53
Z4	KIN	K5	6387663	1936207	K5-29	2563+94	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	195.61	206.33	10.73
Z4	KIN	K6	6363341	1987111	K6-01	approx 1992+00	15'x10' DBL RCBC	Culvert under Iona Ave and systems road	N/A	230	25	280	N/A	N/A	N/A
Z4	KIN	K6	6363233	1982583.1	K6-02	2038+56	11'x15' DBL RCBC	People's Ditch/New Deal Ditch	90.00	120	25	170	202.71	227.06	24.35
Z4	KIN	K6	6365638	1973923	K6-03	2128+46	12'x5' RCBC	Lakeside Ditch - Youd Branch	108.00	120	25	170	210.82	225.05	14.22
Z4	KIN	K6	6365829	1973368.2	K6-04	2134+33	10'x7' DBL RCBC	Lakeside Ditch - Alcorn Branch	90.00	136	25	186	209.25	225.53	16.28
Z4	KIN	K6	6366613	1971248.9	K6-05	2156+95	8'x6' DBL RCBC	Unnamed Ditch	111.00	128	25	178	203.11	220.71	17.60
Z4	KIN	K6	6367189	1969832.7	K6-06	2172+22	10'x4' RCBC	Unnamed Ditch	114.00	128	25	178	204.02	217.43	13.41
Z4	KIN	K6	6368080	1967823.7	K6-07	2194+19	8'x4' RCBC	Unnamed Ditch	115.00	128	25	178	202.54	215.89	13.36
Z4	KIN	K6	6369657	1964680.9	K6-08	2229+36	8'x6' DBL RCBC	Unnamed Ditch	90.00	123	25	173	202.44	213.88	11.44
Z4	KIN	K6	6370971	1962369.9	K6-09	2256+41	15'x14' TRPL RCBC	Melga Canal	90.00	128	25	178	199.53	212.23	12.70
Z4	KIN	K6	6373438	1958574.2	K6-10	2301+25	10'x4' RCBC	Unnamed Ditch	90.00	120	25	170	198.21	211.1	12.89
Z4	KIN	K6	6373859	1957971.3	K6-11	2308+39	8'x6' DBL RCBC	Lakeside Ditch - Guernsey Branch	90.00	113	25	163	199.25	211	11.74
Z4	KIN	K6	6377035	1953385.4	K6-12	2364+36	15'x10 DBL RCBC	Hamar Ditch	90.00	185	25	235	196.55	211.04	14.49
Z4	KIN	K6	6377709	1952323.7	K6-13	2376+96	13'x12' TRPL RCBC	Unnamed Ditch	90.00	212	25	262	196.53	213.68	17.15
Z4	KIN	K6	6378154	1951604.8	K6-14	2385+40.12	5'x3' RCBC	Periodic hydraulic relief	90.00	197	0	197	197.07	216.37	19.30
Z4	KIN	K6	6378609	1950829.1	K6-15	2394+39.48	5'x3' RCBC	Periodic hydraulic relief	90.00	122	0	122	196.69	219.23	22.54
Z4	KIN	K6	6379622	1949027.5	K6-16	2414+97	13'x13' TRPL RCBC	Unnamed Ditch	90.00	124	25	174	197.6	225.5	27.90
Z4	KIN	K6	6381756	1945452	K6-17	2456+70	320' BRIDGE	Cross Creek	46.00	124	0	124	188.7	226.26	37.56
Z4	KIN	K6	6384176	1941317.3	K6-18	2504+60	12'x8' DBL RCBC	Unnamed Canal	90.00	116	25	166	190.98	225.945	34.
Z4	KIN	K6	6386434	1937458.6	K6-19	2549+31	15'x16' TRPL RCBC, on viaduct	West Branch Lakeland Canal	73.00	120	25	170	193.26	225.63	32.37
Z4	KIN	K6	6386878	1936699.6	K6-20	2558+00	5'x3' RCBC	Periodic hydraulic relief	90.00	196	0	196	195.36	221.95	26.59
Z4	KIN	K6	6387095	1936329.2	K6-21	2562+40	10'x3' RCBC	Wildlife Crossing Structure	90.00	152	0	73	196.12	219.64	23.53
Z4	KIN	K6	6387383	1935837.8	K6-22	2568+00	5'x3' RCBC	Periodic hydraulic relief	90.00	152	0	152	195.54	216.55	21.01
Z4	KIN	K6	6387787	1935146.6	K6-23	2576+10	10'x3' RCRC	Wildlife Crossing Structure	90.00	151	0	73	194.57	212.93	18.36
Z4	KIN	K6	6387853	1935035.3	K6-24	2577+50	5'x3' RCBC	Periodic hydraulic relief	90.00	151	0	151	195.56	212.56	16.99
Z4	KIN	K6	6388975	1934327.3	K6-25	approx 2588+00	15'x20' 4xRCBC	Culvert under Nevada Ave, Sweet Canal	N/A	377	25	427	N/A	N/A	N/A
Z4	KIN	K6	6387036	1933799.6	K6-26	approx 2592+00	15'x11' DBL RCBC	Culvert under Nevada Ave access road, Bean Ditch	N/A	166	25	216	N/A	N/A	N/A
Z4	KIN	K6	6387423	1933733.7	K6-27	approx 2592+00	15'x11' DBL RCBC	Culvert under Nevada Ave access road, Unnamed Canal	N/A	55	25	105	N/A	N/A	N/A
Z4	KIN	K6	6388582	1933789.5	K6-28	2591+79	15'x15' TRPL RCBC	Bean Ditch	118.00	175	25	225	196.05	209.57	13.52
Z4	KIN	C1	6387832	1935915.9	C1-01	2605+00.86	5'x3' RCBC	Periodic hydraulic relief	90.00	126	0	126	195.85	206.61	10.76
Z4	KIN	C1	6388276	1935158.7	C1-02	2613+78.88	5'x3' RCBC	Periodic hydraulic relief	90.00	126	0	126	196	207.14	11.14
Z4	KIN	C1	6389356	1933852.3	C1-03	approx 2629+00	15'x22' 4x RCBC	Culvert under Nevada Ave, Sweet Canal	N/A	424	25	474	N/A	N/A	N/A
Z4	KIN	C1	6389081	1933782.2	C1-04	2629+74	15'x14' TRPL RCBC	Bean Ditch	N/A	126	25	176	197.66	206.96	9.30
Z4	KIN	C1	6387662	1933801.1	C1-05	approx 2630+00	15'x12' DBL RCBC	Culvert under Nevada Ave access road, Bean Ditch	N/A	70	25	120	N/A	N/A	N/A
Z4	KIN	C1	6388769	1933549.2	C1-06	approx 2631+00	10'x8' DBL RCBC	Culvert under Nevada Ave access road, Unnamed Ditch	N/A	124	26	176	N/A	N/A	N/A
Z4	KIN	C1	6391306	1933770.2	C1-07	approx 2630+00	14'x20' 4x RCBC	Culvert under systems road, Bean Ditch	N/A	70	27	124	N/A	N/A	N/A
Z4	KIN	C1	6389852	1932464.4	C1-08	2645+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	130	0	130	192.98	206.66	13.68
Z4	KIN	C1	6390608	1931170.4	C1-09	2660+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	130	0	130	194.42	206.33	11.91
Z4	KIN	C1	6391367	1929875.3	C1-10	2675+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	130	0	130	193.44	206.46	13.02

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Z4	KIN	C1	6392123	1928579.8	C1-11	2690+03.61	15'x6' RCBC	Unnamed ditch	90.00	100	25	150	191.77	215.15	23.39
Z4	KIN	C1	6392776	1927463.1	C1-12	2702+93.52	10'x3' RCBC	Wildlife Crossing Structure	90.00	100	0	80	193.79	224.03	30.24
Z4	KIN	C1	6395150	1923238.8	C1-13	2751+39.43	16'x7' RCBC	North Corcoran Ditch	120.00	80	25	90	192.13	242.88	50.74
Z4	KIN	C1	6395263	1923240.3	C1-14	approx 2751+00	16'x7' RCBC	Culvert under systems road, North Corcoran Ditch	N/A	40	0	128	N/A	N/A	N/A
Z4	KIN	C1	6401835	1911405.8	C1-15	2887+30	60" RCP	Hayes Lateral Canal	90.00	128	25	178	191.44	234.61	43.17
Z4	KIN	C1	6402358	1910045	C1-16	approx 2902+50	8'x10' DBL RCBC	cuvert under systems road	N/A	167	0	167	N/A	N/A	N/A
Z4	KIN	C1	6402430	1910279.5	C1-17	2900+06	15'x20' 4xRCBC	Sweet Canal	90.00	70	0	70	194.15	231.48	37.32
Z4	KIN	C1	6402473	1910303.2	C1-18	approx 2900+06	60' BRIDGE	Bridge under BNSF - Sweet Canal	N/A	20	0	20	N/A	N/A	N/A
Z4	KIN	C1	6402537	1910340	C1-19	approx 2900+06	14'x20' 4x RCBC	Culvert under road - Sweet Canal	N/A	74	0	74	N/A	N/A	N/A
Z4	KIN	C1	6403088	1908832.1	C1-20	approx 2916+00	14'x20' 4x RCBC	Culvert under road	N/A	193	0	193	N/A	N/A	N/A
Z4	KIN	C1	6404063	1907352.2	C1-21	2933+57.19	16'x12' DBL RCBC	Unknown canal	120.00	118	25	168	182.76	219.52	36.76
Z4	KIN	C1	6404439	1906710.9	C1-22	2941+01.23	5'x3' RCBC	Periodic hydraulic relief	90.00	118	0	118	192.1	215.6	23.49
Z4	KIN	C1	6405299	1905243.8	C1-23	2949+00.19	10'x3' RCBC	Wildlife Crossing Structure	90.00	118	0	118	192.35	211.39	19.04
Z4	KIN	C1	6404843	1906021.7	C1-24	2958+01.01	5'x3' RCBC	Periodic hydraulic relief	90.00	136	0	136	193.2	207.61	14.41
Z4	KIN	C1	6405653	1904641.4	C1-25	2965+00.27	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	193.56	206.4	12.84
Z4	KIN	C1	6406108	1903864.5	C1-26	2974+00.11	5'x3' RCBC	Periodic hydraulic relief	90.00	136	0	136	193.5	205.24	11.75
Z4	KIN	C1	6406487	1903218.3	C1-27	2981+50.14	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	193.51	204.28	10.77
Z4	KIN	C1	6406816	1902656.8	C1-28	2988+00.96	5'x3' RCBC	Periodic hydraulic relief	90.00	136	0	136	193.9	204.28	10.39
Z4	KIN	C1	6406821	1902379.9	C1-29	approx 2991+00	11'x9' DBL RCBC	Culvert under Ave 144 and systems road	N/A	618	25	668	N/A	N/A	N/A
Z4	KIN	C1	6407372	1901708.6	C1-30	2998+99.93	10'x3' RCBC	Wildlife Crossing Structure	90.00	118	0	118	194.03	208.51	14.48
Z4	KIN	C1	6407777	1901018.4	C1-31	3007+00.11	5'x3' RCBC	Periodic hydraulic relief	90.00	118	0	118	194.48	214.34	19.86
Z4	KIN	C1	6408054	1900545.3	C1-32	3012+48.38	10'x3' RCBC	Wildlife Crossing Structure	90.00	118	0	118	194.9	218.45	23.55
Z4	KIN	C1	6408535	1899723.4	C1-33	3022+00.83	5'x3' RCBC	Periodic hydraulic relief	90.00	118	0	118	195.07	224.13	29.06
Z4	TUL	C1	6408839	1899206.9	C1-34	3027+99.95	10'x3' RCBC	Wildlife Crossing Structure	90.00	118	0	118	198.59	225.7	27.11
Z4	TUL	C1	6408957	1899015.6	C1-35	3030+24.99	240' Bridge	Tule River	109.00	118	0	118	182.58	225.88	43.30
Z4	TUL	C1	6409142	1898689.1	C1-36	3034+00.18	10'x3' RCBC	Wildlife Crossing Structure	90.00	118	0	118	193.51	225.7	32.19
Z4	TUL	C1	6409538	1898014.5	C1-37	3041+82.23	10'x5' RCBC	Unnamed ditch	90.00	118	25	168	194.55	223.34	28.78
Z4	TUL	C1	6410305	1896704.5	C1-38	3057+00.34	10'x3' RCBC	Wildlife Crossing Structure	90.00	118	0	118	195.95	213.39	17.44
Z4	TUL	C1	6411823	1894117	C1-39	3087+00.20	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	195	206.29	11.29
Z4	KIN	C2	6387923	1935762.8	C2-01	2600+00.21	5'x3' RCBC	Periodic hydraulic relief	90.00	131	0	131	195.7	206.75	11.05
Z4	KIN	C2	6388276	1935158.9	C2-02	2607+00.21	5'x3' RCBC	Periodic hydraulic relief	90.00	131	0	131	196	207.3	11.30
Z4	KIN	C2	6388768	1933548.9	C2-03	approx 2624+00	10'x5' DBL RCBC	Culvert under Nevada Ave access road, Unnamed Ditch	N/A	69	25	119	N/A	N/A	N/A
Z4	KIN	C2	6389114	1933778.2	C2-04	2623+10	15'x15' TRPL RCBC	Bean Ditch	N/A	129	25	179	196.48	208.46	11.98
Z4	KIN	C2	6389356	1933852.3	C2-05	approx 2623+01	15'x22' 4x RCBC	Culvert under Nevada Ave, Sweet Canal	N/A	434	25	484	N/A	N/A	N/A
Z4	KIN	C2	6391306	1933770.2	C2-06	approx 2623+00	14'x20' 4x RCBC	Culvert under systems road, Bean Ditch	N/A	69	0	69	N/A	N/A	N/A
Z4	KIN	C2	6387662	1933801.3	C2-07	approx 2623+00	15'x17' 3xRCBC	Culvert under Nevada Ave access road, Bean Ditch	N/A	72	0	72	N/A	N/A	N/A
Z4	KIN	C2	6389769	1932790.4	C2-08	2635+00.38	10'x3' RCBC	Wildlife Crossing Structure	90.00	145	0	145	193.8	209.39	15.59
Z4	KIN	C2	6390647	1931575.4	C2-09	2649+99.72	10'x3' RCBC	Wildlife Crossing Structure	90.00	140	0	140	193.68	206.38	12.69
Z4	KIN	C2	6391580	1930400.6	C2-10	2664+99.96	10'x3' RCBC	Wildlife Crossing Structure	90.00	122	0	122	193.84	203.36	9.52
Z4	KIN	C2	6392364	1929492.4	C2-11	2676+99.95	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	194.24	204.25	10.00
Z4	KIN	C2	6393152	1928644	C2-12	2688+57.05	14'x6' RCBC	Unnamed ditch	90.00	120	25	170	194.63	205.24	10.61
Z4	KIN	C2	6394170	1927622.8	C2-13	2702+99.93	10'x3' RCBC	Wildlife Crossing Structure	90.00	131	0	131	195.34	206.47	11.14
Z4	KIN	C2	6395244	1926575.5	C2-14	2717+99.93	10'x3' RCBC	Wildlife Crossing Structure	90.00	131	0	131	194.9	207.76	12.86
Z4	KIN	C2	6411650	1894411.8	C2-15	approx 2730+00	16'x21' 4xRCBC	Culvert under Niles Ave, Sweet canal	N/A	80	0	80	N/A	N/A	N/A
Z4	KIN	C2	6396245	1925596.3	C2-16	2732+00.19	16'x21' 4xRCBC	Sweet canal	90.00	138	25	188	194.65	208.95	14.30
Z4	KIN	C2	6397359	1924447.5	C2-17	2748+00.10	10'x3' RCBC	Wildlife Crossing Structure	90.00	140	0	140	196.66	210.32	13.66
Z4	TUL	C2	6396790	1923211.4	C2-18	approx 2759+00	15'x6' RCBC	Culvert under Orange Ave turnout, North Corcoran Ditch	N/A	40	0	40	N/A	N/A	N/A
Z4	TUL	C2	6398328	1923345.3	C2-19	2762+68.41	11'x8' DBL RCBC	Ax Canal and culvert extended under road	N/A	140	25	190	195.23	211.19	N/A

ZONE	COUNTY	HST ALIGN	Easting	Northing	Point ID	Sta #	Proposed Facility (internal width x internal height)	Purpose/ Existing Feature Crossed	Crossing angle (clockwise from North)	ROW width (ft)	additional dist. either side (ft)	Total length of channel spanned by culvert (ft)	Existing Elevation (of INV)	Proposed Elevation (of track)	Distance to Top of Rail (ft)
Z4	TUL	C2	6397839	1923340.9	C2-20	approx 2760+00	15'x14' 4x RCBC	Culvert under Orange Ave, Sweet Canal	N/A	400	25	450	N/A	N/A	N/A
Z4	TUL	C2	6399347	1924151.1	C2-21	approx 2761+00	11'x8' DBL RCBC	Culvert under Orange Ave turnout,Ax Canal	N/A	60	0	60	N/A	N/A	N/A
Z4	TUL	C2	6397670	1923307.2	C2-22	approx 2760+00	13'x6' DBL RCBC	Culvert under Orange Ave, North Corcoran Ditch	N/A	320	25	46	N/A	N/A	N/A
Z4	TUL	C2	6399529	1921831.8	C2-23	2782+00.58	10'x3' RCBC	Wildlife Crossing Structure	90.00	140	0	140	196.85	210.56	13.71
Z4	TUL	C2	6400423	1920566.1	C2-24	2797+50.04	10'x3' RCBC	Wildlife Crossing Structure	90.00	140	0	140	197.01	210.01	13.00
Z4	TUL	C2	6401781	1918351.4	C2-25	2823+48.94	10'x3' RCBC	Wildlife Crossing Structure	90.00	130	0	130	196.53	208.24	11.71
Z4	TUL	C2	6402504	1916979.6	C2-26	2839+00.00	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	196.4	206.28	9.87
Z4	TUL	C2	6403161	1915574.1	C2-27	2854+51.50	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	195.33	205.56	10.23
Z4	TUL	C2	6403603	1914514.1	C2-28	2865+99.79	5'x3' RCBC	Periodic hydraulic relief	90.00	130	0	130	194.75	205.6	10.85
Z4	TUL	C2	6403956	1913578.5	C2-29	2875+99.93	10'x3' RCBC	Wildlife Crossing Structure	90.00	130	0	130	194.51	205.63	11.12
Z4	TUL	C2	6404277	1912630.3	C2-30	2886+01.09	12'x8' DBL RCBC	Unknown canal	90.00	130	25	180	190.48	205.66	15.19
Z4	TUL	C2	6404490	1911963.6	C2-31	2893+00.98	5'x3' RCBC	Periodic hydraulic relief	90.00	130	0	130	194.22	205.69	11.46
Z4	TUL	C2	6404710	1911195.7	C2-32	2900+99.93	10'x3' RCBC	Wildlife Crossing Structure	90.00	130	0	130	194.35	205.71	11.37
Z4	TUL	C2	6404892	1910519.8	C2-33	2907+99.93	5'x3' RCBC	Periodic hydraulic relief	90.00	130	0	130	194.16	205.74	11.58
Z4	TUL	C2	6405095	1909745.2	C2-34	2916+00.54	10'x3' RCBC	Wildlife Crossing Structure	90.00	130	0	130	194.21	205.76	11.55
Z4	TUL	C2	6405299	1908972.5	C2-35	2923+99.68	5'x3' RCBC	Periodic hydraulic relief	90.00	130	0	130	194.85	205.79	10.94
Z4	TUL	C2	6405476	1908295.1	C2-36	2930+99.93	10'x3' RCBC	Wildlife Crossing Structure	90.00	130	0	130	194.48	205.81	11.33
Z4	TUL	C2	6405733	1907340.4	C2-37	2940+88.61	10'x8' DBL RCBC	Unknown canal	107.00	130	25	180	191.1	205.84	14.74
Z4	TUL	C2	6405958	1906560	C2-38	2949+00.71	5'x3' RCBC	Periodic hydraulic relief	90.00	130	0	130	193.74	205.87	12.13
Z4	TUL	C2	6406203	1905769.2	C2-39	2957+28.57	36" RCP	Unnamed ditch	90.00	130	25	180	193.92	205.9	11.98
Z4	TUL	C2	6406541	1904752.9	C2-40	2967+99.92	5'x3' RCBC	Periodic hydraulic relief	90.00	130	0.00	130	194.3	206.59	12.29
Z4	TUL	C2	6408999	1899032.2	C2-41	3030+31.12	70' span on viaduct	Tule River	97.00	80	0.00	80	182.72	235.19	52.47
Z4	TUL	C2	6409549	1898023.3	C2-42	3041+80.05	10'x5' RCBC	Unknown canal	90.00	103	25	153	194.91	228.42	33.51
Z4	TUL	C2	6410508	1896360.1	C2-43	3060+99.88	10'x3' RCBC	Wildlife Crossing Structure	90.00	119	0.00	119	193.02	216.91	23.89
Z4	TUL	C2	6411974	1893858.3	C2-44	3089+99.86	10'x3' RCBC	Wildlife Crossing Structure	90.00	135	0	135	196.24	206.19	9.95
Z4	KIN	C3	6389329	1932512.4	C3-01	2642+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	272	0	272	194.01	206.85	12.85
Z4	KIN	C3	6390113	1931173.7	C3-02	2657+51	10'x3' RCBC	Wildlife Crossing Structure	90.00	135	0	135	190.55	206.15	15.61
Z4	KIN	C3	6390895	1929836.9	C3-03	2673+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	137	0	137	190.55	205.89	15.34
Z4	KIN	C3	6391678	1928499.8	C3-04	2688+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	137	0	137	190.56	205.62	15.05
Z4	KIN	C3	6392461	1927161.5	C3-05	2704+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	194.31	205.35	11.04
Z4	KIN	C3	6393246	1925824.7	C3-06	2719+44	10'x3' RCBC	Wildlife Crossing Structure	90.00	134	0	134	193.53	205.08	11.56
Z4	KIN	C3	6394036	1924491.9	C3-07	2735+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	126	0	126	193.33	204.82	11.49
Z4	KIN	C3	6394831	1923158.3	C3-08	2750+52	10'x3' RCBC	Wildlife Crossing Structure	90.00	113	0	113	196.89	204.57	7.67
Z4	TUL	C3	6395165	1923023.9	C3-09	approx 2763	15'x7' RCBC	Culvert under Orange Ave access road, North Corcoran Ditch	N/A	32	25	82	N/A	N/A	N/A
Z4	TUL	C3	6395759	1923132.9	C3-10	approx 2764	15'x7' RCBC	Culvert under Orange Ave access road, North Corcoran Ditch	N/A	114	25	164	N/A	N/A	N/A
Z4	TUL	C3	6396218	1923156	C3-11	approx 2765	15'x7' RCBC	Culvert under Industrial Ave, North Corcoran Ditch	N/A	32	25	82	N/A	N/A	N/A
Z4	KIN	C3	6412101	1893643.2	C3-12	2766+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	106	0	106	195.76	212.13	16.38
Z4	KIN	C3	6401588	1911209.8	C3-13	approx 2888+00	60" RCP	Hayes Lateral Canal	N/A	84	25	134	N/A	N/A	N/A
Z4	KIN	C3	6401813	1911190.9	C3-14	2889+10	122' Bridge	Sweet Canal	90.00	102	0	102	194.86	214.04	19.1
Z4	TUL	C3	6402592	1909862.1	C3-15	2904+48	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	190.32	205.25	14.93
Z4	TUL	C3	6403376	1908523.6	C3-16	2920+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	138	0	138	188.85	204	15.15
Z4	TUL	C3	6403730	1907919.8	C3-17	2927+00	5'x3' RCBC	Periodic hydraulic relief	90.00	136	0	136	187.07	204	16.93
Z4	TUL	C3	6404063	1907352.8	C3-18	2933+58	16'x12' DBL RCBC	Unknown canal	120.00	136	25	186	182.76	204	21.24
Z4	TUL	C3	6404438	1906711.1	C3-19	2941+00	5'x3' RCBC	Periodic hydraulic relief	90.00	136	0	136	192.12	204	11.88
Z4	TUL	C3	6404843	1906021.7	C3-20	2949+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	192.35	204	11.65
Z4	TUL	C3	6405299	1905244.5	C3-21	2958+00	5'x3' RCBC	Periodic hydraulic relief	90.00	136	0	136	193.2	204	10.80
Z4	TUL	C3	6405626	1904687.2	C3-22	2964+67	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	193.52	204	10.48
Z4	TUL	C3	6406108	1903865.1	C3-23	2974+00	5'x3' RCBC	Periodic hydraulic relief	90.00	136	0	136	193.47	204	10.53

ZONE	COUNTY	HST ALIGN	Easting	Northing	Point ID	Sta #	Proposed Facility (internal width x internal height)	Purpose/ Existing Feature Crossed	Crossing angle (clockwise from North)	ROW width (ft)	additional dist. either side (ft)	Total length of channel spanned by culvert (ft)	Existing Elevation (of INV)	Proposed Elevation (of track)	Distance to Top of Rail (ft)
Z4	TUL	C3	6406435	1903307.6	C3-24	2980+46	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	193.69	204	10.31
Z4	TUL	C3	6406916	1902484.8	C3-25	2990+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	193.78	204.65	10.87
Z4	TUL	C3	6406858	1902028.4	C3-26	approx 2995+00	10'x8' DBL RCBC	Culvert under systems access road	N/A	52	0	52	N/A	N/A	N/A
Z4	TUL	C3	6407372	1901708.6	C3-27	2999+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	194.76	206.85	12.09
Z4	TUL	C3	6407878	1900846	C3-28	3009+00	10'x3' WCS	Wildlife Crossing Structure	90.00	118	0	118	194.59	217.85	23.26
Z4	TUL	C3	6408332	1900068.9	C3-29	3018+00	5'x3' RCBC	Periodic hydraulic relief	90.00	118	0	118	194.66	222.41	27.74
Z4	TUL	C3	6408836	1899219.5	C3-30	3028+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	118	0	118	198.56	225.8	27.24
Z4	TUL	C3	6408957	1899015.6	C3-31	3030+25	240' Bridge	Tule River	95.00	80	0	80	182.58	225.98	43.39
Z4	TUL	C3	6409140	1898702.1	C3-32	3034+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	119	0	119	193.53	225.78	32.25
Z4	TUL	C3	6409538	1898014.5	C3-33	3041+82	10'x5' RCBC	Unknown canal	90.00	119	25	169	194.2	223.32	29.12
Z4	TUL	C3	6409749	1897654.1	C3-34	3046+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	119	0	119	193.92	220.95	27.03
Z4	TUL	C3	6410530	1896322.4	C3-35	3061+44	10'x3' RCBC	Wildlife Crossing Structure	90.00	119	0	119	192.93	210.41	17.48
Z4	TUL	C3	6412101	1893643.2	C3-36	3092+49	10'x3' RCBC	Wildlife Crossing Structure	90.00	212	0	212	194.07	206.11	12.04
Z4	TUL	P	6412612	1892771.4	P-01	3102+60	10'x3' RCBC	Wildlife Crossing Structure	90.00	210	25	260	193.88	205.79	11.90
Z4	TUL	P	6413411	1891408.4	P-02	3118+40	12'x5' RCBC	Beshears Ditch	123.00	268	25	318	188.93	205.28	16.34
Z4	TUL	P	6412436	1891421.8	P-03	approx 3118+00	12'x5' RCBC	Culvert under Ave 128, Beshears Ditch	N/A	254	25	304	N/A	N/A	N/A
Z4	TUL	P	6412938	1891451	P-04	approx 3118+00	12'x5' RCBC	Culvert under Systems road, Beshears Ditch	N/A	57	25	107	N/A	N/A	N/A
Z4	TUL	P	6414109	1890217.9	P-05	3132+20	10'x3' RCBC	Wildlife Crossing Structure	90.00	138	0	138	191.21	204.83	13.62
Z4	TUL	P	6414807	1889027.4	P-06	3146+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	216	0	216	190.9	204.39	13.49
Z4	TUL	P	6415505	1887837	P-07	3159+80	10'x3' RCBC	Wildlife Crossing Structure	90.00	212	0	212	190.94	203.94	13.01
Z4	TUL	P	6415971	1887043.1	P-08	approx 3169+00	11'x8' DBL RCBC	extend culvert under road	N/A	52	25	102.00	N/A	N/A	N/A
Z4	TUL	P	6416189	1886670.6	P-09	3173+25	11'x8' DBL RCBC	Taylor Canal	30.00	136	0	136	187.87	203.48	15.61
Z4	TUL	P	6416903	1885451.7	P-10	3186+45	10'x3' RCBC	Wildlife Crossing Structure	90.00	134	0	134	191.25	203.05	11.80
Z4	TUL	P	6417571	1884313	P-11	3199+65	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	190.62	202.62	12.00
Z4	TUL	P	6418239	1883174.3	P-12	3213+88	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	189.66	202.06	12.40
Z4	TUL	P	6418897	1882051.3	P-13	3226+88	16'x12' DBL RCBC	Culvert under road, Unnamed Ditch	N/A	136	25	186	186.75	201.41	N/A
Z4	TUL	P	6418842	1881314.2	P-14	approx 3233+00	16'x12' DBL RCBC	Unnamed Ditch	N/A	414	25	464	N/A	N/A	N/A
Z4	TUL	P	6419967	1880226.6	P-15	3248+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	134	0	134	186.5	200.35	13.84
Z4	TUL	P	6420748	1878894.7	P-16	3263+46	10'x3' RCBC	Wildlife Crossing Structure	90.00	134	0	134	186.45	199.58	13.12
Z4	TUL	P	6421521	1877574.3	P-17	3278+77	10'x3' RCBC	Wildlife Crossing Structure	90.00	140	0	140	187.04	198.81	11.77
Z4	TUL	P	6422318	1876219.8	P-18	3294+49	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	187.39	198.03	10.63
Z4	TUL	P	6423105	1874881	P-19	3310+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	186.97	199.46	12.48
Z4	TUL	P	6423811	1873671.9	P-20	3324+01	15'x28' 7x RCBC	Lakeland Canal	90.00	136	25	186	190.99	203.42	12.43
Z4	TUL	P	6424141	1873117.1	P-21	3330+46	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	186.15	203.34	17.20
Z4	TUL	P	6424564	1872398.3	P-22	3338+81	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	186.78	202.04	15.26
Z4	TUL	P	6425364	1871036.2	P-23	3354+61	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	188.96	200.4	11.44
Z4	TUL	P	6425587	1870656	P-24	3359+00	5'x3' RCBC	Periodic hydraulic relief	90.00	136	0	136	189.225	200.315	11
Z4	TUL	P	6425994	1869965.9	P-25	3367+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	189.49	200.23	10.74
Z4	TUL	P	6426803	1868587.3	P-26	3383+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	186	0	186	188.24	200.06	11.82
Z4	TUL	P	6427611	1867202.1	P-27	3399+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	186	0	186	184.82	201.92	17.10
Z4	TUL	P	6428423	1865826.3	P-28	3415+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	186	0	186	189.79	204.69	14.90
Z4	TUL	P	6429081	1864704.3	P-29	3428+00	5'x3' RCBC	Periodic hydraulic relief	90.00	136	0	136	191.495	205.345	13
Z4	TUL	P	6430121	1862943.3	P-30	3448+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	178	0	178	193.2	206	12.80
Z4	TUL	A1	6430920	1861581.4	A1-01	3924+53	10'x3' RCBC	Wildlife Crossing Structure	90.00	185	0	185	193.44	206	12.56
Z4	TUL	A1	6431705	1860246.9	A1-02	3940+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	185	0	185	193.76	206	12.24
Z4	TUL	A1	6432469	1858944.2	A1-03	3955+10	10'x3' RCBC	Wildlife Crossing Structure	90.00	185	0	185	193.87	206	12.13
Z4	TUL	A1	6433246	1857568.7	A1-04	3970+90	10'x3' RCBC	Wildlife Crossing Structure	90.00	168	0	168	193.57	206	12.43

ZONE	COUNTY	HST ALIGN	Easting	Northing	Point ID	Sta #	Proposed Facility (internal width x internal height)	Purpose/ Existing Feature Crossed	Crossing angle (clockwise from North)	ROW width (ft)	additional dist. either side (ft)	Total length of channel spanned by culvert (ft)	Existing Elevation (of INV)	Proposed Elevation (of track)	Distance to Top of Rail (ft)
Z4	TUL	A1	6433981	1856169.8	A1-05	3986+71	10'x3' RCBC	Wildlife Crossing Structure	90.00	144	0	144	193.76	209.18	15.42
Z4	TUL	A1	6434671	1854748.6	A1-06	4002+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	144	0	144	195.53	220.48	24.95
Z4	TUL	A1	6434845	1854371	A1-07	4006+66	viaduct, 90' span	Deer Creek	166.00	80	0	90	192.69	223.64	30.95
Z4	TUL	A1	6437137	1848362.8	A1-08	4071+00	5'x3' RCBC	Periodic hydraulic relief	90.00	100	0	100	195.29	220.47	25.18
Z4	TUL	A1	6437324	1847747.1	A1-09	4077+44	10'x3' RCBC	Wildlife Crossing Structure	90.00	100	0	100	194.37	213.89	19.52
Z4	TUL	A1	6437558	1846924.5	A1-10	4086+00	5'x3' RCBC	Periodic hydraulic relief	90.00	100	0	100	194.54	207.82	13.28
Z4	TUL	A1	6437739	1846263.6	A1-11	4092+85	5'x3' RCBC	Periodic hydraulic relief	105.00	120	0	120	194.64	205.16	10.51
Z4	TUL	A1	6437868	1845764.2	A1-12	4098+00	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	194.68	204.55	9.86
Z4	TUL	A1	6438021	1845141.6	A1-13	4104+41	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	194.72	204.62	9.90
Z4	TUL	A1	6438148	1844597.6	A1-14	4110+00	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	194.62	204.69	10.07
Z4	TUL	A1	6438264	1844075.5	A1-15	4115+34	15'x11' DBL RCBC	Unnamed Ditch	90.00	120	25	170	194.92	204.76	9.85
Z4	TUL	A1	6438371	1843567.9	A1-16	4120+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	194.51	204.95	10.44
Z4	TUL	A1	6438547	1842704.1	A1-17	412900	10'x3' RCBC	Wildlife Crossing Structure	90.00	153	0	153	194.39	204.93	10.53
Z4	TUL	A1	6438686	1841918	A1-18	413700	5'x3' RCBC	Periodic hydraulic relief	90.00	153	0	153	194.4	205.03	10.63
Z4	TUL	A1	6438811	1841121.5	A1-19	4146+10	10'x3' WCS	Unnamed Ditch	90.00	153	25	203	193.57	205.22	11.65
Z4	TUL	A1	6438905	1840467.6	A1-20	4152+00	5'x3' RCBC	Periodic hydraulic relief	90.00	153	0	153	195.12	205.55	10.43
Z4	TUL	A1	6439001	1839774.6	A1-21	4159+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	194.96	205.45	10.50
Z4	TUL	A1	6439073	1839178.9	A1-22	4165+00	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	195.21	206.29	11.09
Z4	TUL	A1	6439145	1838517.3	A1-23	4171+77	14'x7' RCBC	Unnamed Ditch	95.00	120	25	170	193.71	206.68	12.96
Z4	TUL	A1	6439215	1837784.8	A1-24	4179+00	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	195.8	207.09	11.29
Z4	TUL	A1	6439264	1837188.2	A1-25	4185+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	195.77	207.44	11.67
Z4	TUL	A1	6439365	1835927.2	A1-26	4197+80	12'x6' RCBC	White River Canal	90.00	120	25	170	199.13	208.15	9.03
Z4	TUL	A1	6439494	1834324.9	A1-27	4213+73	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	196.4	208.39	11.99
Z4	TUL	A1	6439580	1833241	A1-28	4224+60	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	197.73	207.8	10.07
Z4	TUL	A1	6439703	1831706	A1-29	4240+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	196.98	207.12	10.14
Z4	TUL	A1	6439750	1831130.9	A1-30	4245+76	12'x11' TRPL RCBC	Unnamed Ditch	90.00	120	25	170	197.91	206.84	8.93
Z4	TUL	A1	6439806	1830409.6	A1-31	4258+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	199.95	206.97	7.03
Z4	TUL	A1	6439931	1828869.9	A1-32	4268+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	198.55	207.59	9.04
Z4	TUL	A1	6440054	1827320	A1-33	4284+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	161	0	161	197.7	208.21	10.50
Z4	TUL	A1	6440216	1825316.6	A1-34	4304+10	13'x6' RCBC	Unnamed Ditch	94.00	161	25	211	194.8	209.01	14.21
Z4	TUL	A1	6440342	1823731.4	A1-35	4320+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	161	0	161	198.09	209.64	11.56
Z4	TUL	A1	6440465	1822186.3	A1-36	4335+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	161	0	161	201.25	211.25	9.99
Z4	TUL	A1	6440589	1820641.3	A1-37	4351+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	161	0	161	205.68	214.9	9.22
Z4	TUL	A1	6440713	1819095.1	A1-38	4366+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	161	0	161	207.82	217.71	9.88
Z4	TUL	A1	6440837	1817551.2	A1-39	4382+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	161	0	161	207.77	219.23	11.46
Z4	TUL	A1	6440960	1816009.8	A1-40	4397+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	208.68	220.76	12.08
Z4	TUL	A1	6441087	1814434.8	A1-41	4413+30	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	210.94	222.31	11.37
Z4	TUL	A1	6441213	1812859.9	A1-42	4429+10	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	212.96	223.82	10.87
Z4	TUL	A1	6441339	1811284.9	A1-43	4444+90	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	214.59	224.85	10.27
Z4	TUL	A1	6441465	1809707	A1-44	4460+70	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	216.39	225.82	9.43
Z4	TUL	A1	6441610	1808135.3	A1-45	4476+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	217.85	226.78	8.93
Z5	KER	A1	6441807	1806569.5	A1-46	4492+30	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	218.86	227.74	8.88
Z5	KER	A1	6442058	1805013.6	A1-47	4508+10	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	218.45	228.7	10.25
Z5	KER	A1	6442366	1803452.9	A1-48	4523+90	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	218.38	229.67	11.29
Z5	KER	A1	6442727	1801920.5	A1-49	4539+70	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	219.65	230.73	11.08
Z5	KER	A1	6443141	1800396.3	A1-50	4555+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	223.05	233.01	9.96
Z5	KER	A1	6443610	1798884.6	A1-51	4571+30	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	225.1	235.49	10.39
Z5	KER	A1	6444128	1797392	A1-52	4587+10	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	225.89	237.97	12.07
Z5	KER	A1	6444704	1795918.6	A1-53	4602+90	10'x3' RCBC	Wildlife Crossing Structure	90.00	152	0	152	229.03	240.45	11.42

ZONE	COUNTY	HST ALIGN	Easting	Northing	Point ID	Sta #	Proposed Facility (internal width x internal height)	Purpose/ Existing Feature Crossed	Crossing angle (clockwise from North)	ROW width (ft)	additional dist. either side (ft)	Total length of channel spanned by culvert (ft)	Existing Elevation (of INV)	Proposed Elevation (of track)	Distance to Top of Rail (ft)
Z5	KER	A1	6445326	1794470.9	A1-54	4618+70	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	232.68	242.92	10.24
Z5	KER	A1	6446001	1793050.3	A1-55	4634+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	171	0	171	235.24	245.31	10.06
Z5	KER	A1	6446725	1791638.6	A1-56	4650+30	10'x3' RCBC	Wildlife Crossing Structure	90.00	171	0	171	234.88	249.66	14.78
Z5	KER	A1	6447212	1790757.8	A1-57	4660+34	10'x3' RCBC	Wildlife Crossing Structure	90.00	139	0	139	236.96	254.51	17.56
Z5	KER	A1	6447602	1790083.5	A1-58	4669+11	16'x12' DBL RCBC	Unnamed canal	31.00	170	25	220	243.9	258.15	14.25
Z5	KER	A1	6448114	1789238.8	A1-59	4678+00	10'x3' RCBC	Vernal Pool/ Wildlife crossing structure	90.00	145	0	145	240.83	258.01	17.18
Z5	KER	A1	6448596	1788478.9	A1-60	4687+04	10'x3' RCBC	Vernal Pool/ Wildlife crossing structure	90.00	145	0	145	243.02	256.1	13.08
Z5	KER	A1	6448903	1788011	A1-61	4692+60	10'x3' RCBC	Vernal Pool/ Wildlife crossing structure	90.00	120	0	120	243.62	254.95	11.33
Z5	KER	A1	6449461	1787193.3	A1-62	4702+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	245.47	254.94	9.46
Z5	KER	A1	6450796	1785381.7	A1-63	4725+00	5'x3' RCBC	Periodic hydraulic relief	90.00	120	1	122	249.05	260.06	11.01
Z5	KER	A1	6451323	1784714.9	A1-64	4733+50.00	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	249.05	260.06	11.01
Z5	KER	A1	6452295	1783508	A1-65	4748+99.93	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	251.89	262.62	10.73
Z5	KER	A1	6453423	1782102.5	A1-66	4764+49.97	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	254.96	265.18	10.22
Z5	KER	A1	6454213	1781072.9	A1-67	4780+00.00	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	256.91	267.74	10.83
Z5	KER	A1	6455117	1779813.7	A1-68	4795+50.00	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	260.31	270.3	10.00
Z5	KER	A1	6455917	1778617.9	A1-69	4809+88.60	10'x4' RCBC	floodplain drainage	90.00	120	0	120	263.06	272.82	9.75
Z5	KER	A1	6455950	1778566.1	A1-70	4810+50.00	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	263.41	272.93	9.52
Z5	KER	A1	6456191	1778186.6	A1-71	4814+99.94	10'x4' RCBC	floodplain drainage	90.00	120	0	120	263.54	273.82	10.28
Z5	KER	A1	6456455	1777762	A1-72	4819+99.97	10'x4' RCBC	floodplain drainage	90.00	120	0	120	264.56	274.8	10.24
Z5	KER	A1	6456715	1777334.5	A1-73	4824+99.96	10'x4' RCBC	floodplain drainage	90.00	120	0	120	265.1	275.78	10.67
Z5	KER	A1	6456817	1777162.7	A1-74	4826+99.92	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	265.69	276.17	10.48
Z5	KER	A1	6456969	1776904.1	A1-75	4830+00.03	10'x4' RCBC	floodplain drainage	90.00	120	0	120	266.23	276.76	10.53
Z5	KER	A1	6457219	1776471	A1-76	4834+99.92	10'x4' RCBC	floodplain drainage	90.00	120	0	120	267.13	277.74	10.60
Z5	KER	A1	6457464	1776035	A1-77	4840+00.07	10'x4' RCBC	floodplain drainage	90.00	120	0	120	268.35	278.72	10.36
Z5	KER	A1	6457560	1775859.9	A1-78	4842+00.00	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	268.5	279.11	10.61
Z5	KER	A1	6457704	1775596.5	A1-79	4844+99.95	10'x4' RCBC	floodplain drainage	90.00	120	0	120	268.72	279.7	10.98
Z5	KER	A1	6457939	1775155.3	A1-80	4849+99.97	10'x4' RCBC	floodplain drainage	90.00	120	0	120	269.97	280.68	10.70
Z5	KER	A1	6458009	1775022.3	A1-81	4851+50.00	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	270.18	280.97	10.80
Z5	KER	A1	6458169	1774711.5	A1-82	4854+99.97	10'x4' RCBC	floodplain drainage	90.00	151	0	151	270.79	281.66	10.87
Z5	KER	A1	6458395	1774264.9	A1-83	4860+00.33	10'x4' RCBC	floodplain drainage	90.00	151	0	151	271.46	282.64	11.18
Z5	KER	A1	6458603	1773839	A1-84	4864+74.50	10'x4' RCBC	floodplain drainage	90.00	151	0	151	272.11	283.57	11.46
Z5	KER	A1	6458702	1773636	A1-85	4867+00.00	10'x3' RCBC	Wildlife Crossing Structure	90.00	151	0	151	272.46	284.01	11.55
Z5	KER	A1	6458823	1773381.1	A1-86	4869+82.20	10'x4' RCBC	floodplain drainage	90.00	151	0	151	272.89	284.56	11.67
Z5	KER	A1	6459034	1772926.2	A1-87	4874+83.67	10'x4' RCBC	floodplain drainage	90.00	151	0	151	273.48	285.55	12.06
Z5	KER	A1	6459236	1772478.3	A1-88	4879+75.09	10'x4' RCBC	floodplain drainage	90.00	120	0	120	274.82	286.51	11.69
Z5	KER	A1	6459346	1772226.6	A1-89	4882+50.00	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	275.52	287.05	11.53
Z5	KER	A1	6459433	1772025.8	A1-90	4884+68.77	10'x4' RCBC	floodplain drainage	90.00	120	0	120	276.03	287.48	11.44
Z5	KER	A1	6459626	1771573.7	A1-91	4889+60.16	10'x4' RCBC	floodplain drainage	90.00	120	0	120	276.74	288.44	11.70
Z5	KER	A1	6459817	1771109.7	A1-92	4894+61.82	10'x4' RCBC	floodplain drainage	90.00	120	0	120	277.44	289.42	11.99
Z5	KER	A1	6459942	1770795.8	A1-93	4898+00.00	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	277.72	290.09	12.37
Z5	KER	A1	6460003	1770642	A1-94	4899+65.36	10'x4' RCBC	floodplain drainage	90.00	120	0	120	277.78	290.41	12.63
Z5	KER	A1	6460211	1770101.2	A1-95	4905+44.72	10'x4' DBL RCBC	floodplain drainage	90.00	120	0	120	279.66	291.52	11.86
Z5	KER	A1	6460385	1769632.4	A1-96	4910+44.88	10'x4' DBL RCBC	floodplain drainage	90.00	120	0	120	280.88	292.45	11.56
Z5	KER	A1	6460489	1769345.4	A1-97	4913+50.00	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	281.37	292.99	11.62
Z5	KER	A1	6460554	1769161.1	A1-98	4915+45.52	10'x4' DBL RCBC	floodplain drainage	90.00	120	0	120	281.57	293.35	11.78
Z5	KER	A1	6460718	1768689.3	A1-99	4920+44.83	10'x4' DBL RCBC	floodplain drainage	90.00	120	0	120	282.86	294.24	11.39
Z4	TUL	A2	6430920	1861581.4	A2-01	3924+53	10'x3' RCBC	Wildlife Crossing Structure	90.00	180	0	180	193.44	206	12.56
Z4	TUL	A2	6431721	1860218.5	A2-02	3940+33	10'x3' RCBC	Wildlife Crossing Structure	90.00	180	0	180	196.82	206	9.18

HYDRAULIC CROSSING POINTS

ZONE	COUNTY	HST ALIGN	Easting	Northing	Point ID	Sta #	Proposed Facility (internal width x internal height)	Purpose/ Existing Feature Crossed	Crossing angle (clockwise from North)	ROW width (ft)	additional dist. either side (ft)	Total length of channel spanned by culvert (ft)	Existing Elevation (of INV)	Proposed Elevation (of track)	Distance to Top of Rail (ft)
Z4	TUL	A2	6432522	1858855.8	A2-03	3956+13	10'x3' RCBC	Wildlife Crossing Structure	90.00	179	0	179	194.41	206	11.59
Z4	TUL	A2	6433325	1857487.5	A2-04	3971+98	10'x3' RCBC	Wildlife Crossing Structure	90.00	179	0	179	195.35	206	10.65
Z4	TUL	A2	6434111	1856151.4	A2-05	3987+51	10'x3' RCBC	Wildlife Crossing Structure	90.00	179	0	179	195.56	206.91	11.35
Z4	TUL	A2	6434907	1854796.8	A2-06	4003+22	10'x3' RCBC	Wildlife Crossing Structure	90.00	160	0	160	195.46	216.62	21.16
Z4	TUL	A2	6435155	1854375	A2-07	4008+11	viaduct, 90' span	Deer Creek	65.00	80	0	80	198.05	221.45	23.40
Z4	TUL	A2	6438919	1847969.3	A2-08	4082+40	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	196.49	218.81	22.32
Z4	TUL	A2	6439328	1847273.4	A2-09	4090+47	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	197.48	213.03	15.54
Z4	TUL	A2	6439710	1846622.9	A2-10	4098+00	5'x3' RCBC	Periodic hydraulic relief	90.00	136	0	136	196.83	210.26	13.43
Z4	TUL	A2	6440115	1845934.7	A2-11	4106+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	200.75	209.75	9.00
Z4	TUL	A2	6440899	1844600.1	A2-12	4121+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	202.7	209.75	7.05
Z4	TUL	A2	6441330	1843865.3	A2-13	4130+00	5'x3' RCBC	Periodic hydraulic relief	90.00	136	0	136	197.33	209.75	12.42
Z4	TUL	A2	6441686	1843261.8	A2-14	4137+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	194.73	209.75	15.02
Z4	TUL	A2	6442093	1842573	A2-15	4145+00	5'x3' RCBC	Periodic hydraulic relief	90.00	136	0	136	197.02	209.75	12.73
Z4	TUL	A2	6442471	1841925.2	A2-16	4152+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	206	0	206	196.42	209.75	13.33
Z4	TUL	A2	6442900	1841191.6	A2-17	4161+00	5'x3' RCBC	Periodic hydraulic relief	90.00	172	0	172	196.97	209.75	12.78
Z4	TUL	A2	6443257	1840588.5	A2-18	4168+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	172	0	172	196.98	209.75	12.77
Z4	TUL	A2	6443661	1839898.6	A2-19	4176+00	5'x3' RCBC	Periodic hydraulic relief	90.00	172	0	172	199.23	209.75	10.52
Z4	TUL	A2	6444042	1839250.9	A2-20	4183+53	10'x3' RCBC	Wildlife Crossing Structure	90.00	172	0	172	197.9	209.75	11.85
Z4	TUL	A2	6444371	1838693.3	A2-21	4189+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	172	0	172	199.7	209.75	10.05
Z4	TUL	A2	6444775	1838002.1	A2-22	4198+00	5'x3' RCBC	Periodic hydraulic relief	90.00	172	0	172	197.88	209.75	11.87
Z4	TUL	A2	6445106	1837442.2	A2-23	4204+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	172	0	172	199.85	209.75	9.90
Z4	TUL	A2	6445535	1836709.3	A2-24	4213+00	5'x3' RCBC	Periodic hydraulic relief	90.00	172	0	172	198.24	209.85	11.61
Z4	TUL	A2	6445891	1836106.1	A2-25	4220+00	10'x3' RCBC	Vernal Pool/ Wildlife crossing structure	90.00	172	0	172	194.74	210.5	15.76
Z4	TUL	A2	6446651	1834812.5	A2-26	4235+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	138	0	138	200.75	212.7	11.95
Z4	TUL	A2	6447430	1833464.9	A2-27	4250+57	10'x3' RCBC	Wildlife Crossing Structure	90.00	138	0	138	200.61	214.99	14.39
Z4	TUL	A2	6448200	1832025.4	A2-28	4266+90	14'x14' TRPL RCBC	Unnamed Canal	90.00	128	25	178	202.94	217.4	14.46
Z4	TUL	A2	6448562	1831300.7	A2-29	4275+00	5'x3' RCBC	Periodic hydraulic relief	90.00	128	0	128	205.37	218.59	13.22
Z4	TUL	A2	6448889	1830623	A2-30	4282+52	10'x3' RCBC	Wildlife Crossing Structure	90.00	128	0	128	206.69	219.7	13.01
Z4	TUL	A2	6449200	1829943.5	A2-31	4290+00	5'x3' RCBC	Periodic hydraulic relief	90.00	258	0	258	206.89	220.66	13.77
Z4	TUL	A2	6449523	1829209.7	A2-32	4298+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	129	0	129	208.83	221.2	12.38
Z4	TUL	A2	6450107	1827775.7	A2-33	4313+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	129	0	129	208.84	221.98	13.14
Z4	TUL	A2	6450614	1826404.7	A2-34	4328+10	5'x3' RCBC	Periodic hydraulic relief	0.00	129	0	129	209.78	222.72	12.94
Z4	TUL	A2	6450974	1825334.6	A2-35	4339+36	10'x4' RCBC	Unnamed Ditch	90.00	129	25	179	212.09	223.59	11.50
Z4	TUL	A2	6451428	1823842.8	A2-36	4355+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	129	0	129	211.68	225.12	13.45
Z4	TUL	A2	6451817	1822447.4	A2-37	4369+49	10'x3' RCBC	Wildlife Crossing Structure	90.00	129	0	129	214.86	226.54	11.68
Z4	TUL	A2	6452257	1820855.8	A2-38	4386+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	176	0	176	216.18	228.16	11.98
Z4	TUL	A2	6452669	1819366.6	A2-39	4401+46	10'x3' RCBC	Wildlife Crossing Structure	90.00	176	0	176	218.25	229.68	11.42
Z4	TUL	A2	6453085	1817867.6	A2-40	4417+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	176	0	176	220.75	231.2	10.45
Z4	TUL	A2	6453498	1816375.1	A2-41	4432+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	222.48	233.68	11.20
Z4	TUL	A2	6454063	1814331.8	A2-42	4453+70	100' Bridge	County Line Creek North	90.00	80	0	80	223.23	239	15.77
Z4	TUL	A2	6454329	1813364.8	A2-43	4463+72	10'x3' RCBC	Wildlife Crossing Structure	90.00	145	0	145	226.58	241.16	14.58
Z4	TUL	A2	6454751	1811844.4	A2-44	4479+49	10'x3' RCBC	Wildlife Crossing Structure	90.00	134	0	134	227.26	239.62	12.35
Z4	TUL	A2	6455137	1810446.2	A2-45	4494+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	134	0	134	228.53	239.04	10.51
Z4	TUL	A2	6455551	1808955.7	A2-46	4509+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	134	0	134	232.27	243.94	11.68
Z4	TUL	A2	6456076	1807057.4	A2-47	4529+17	100' Bridge	County Line Creek South	90.00	80	0	80	231.95	250.25	18.31
Z5	KER	A2	6456471	1805627.6	A2-48	4544+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	235.01	248.82	13.80
Z5	KER	A2	6456832	1804323.3	A2-49	4557+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	286	0	286	234.47	247.58	13.11
Z5	KER	A2	6457230	1802887.6	A2-50	4572+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	238.48	249	10.52
Z5	KER	A2	6457577	1801632	A2-51	4585+50	36" RCP	Unknown	90.00	136	0	136	239.18	250.31	11.13

ZONE	COUNTY	HST ALIGN	Easting	Northing	Point ID	Sta #	Proposed Facility (internal width x internal height)	Purpose/ Existing Feature Crossed	Crossing angle (clockwise from North)	ROW width (ft)	additional dist. either side (ft)	Total length of channel spanned by culvert (ft)	Existing Elevation (of INV)	Proposed Elevation (of track)	Distance to Top of Rail (ft)
Z5	KER	A2	6457992	1800134.3	A2-52	4601+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	240.34	252.34	12.01
Z5	KER	A2	6458404	1798646.8	A2-53	4616+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	242.85	254.5	11.65
Z5	KER	A2	6458766	1797339.6	A2-54	4630+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	244.21	256.39	12.19
Z5	KER	A2	6459113	1796087.1	A2-55	4643+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	243.93	258.21	14.28
Z5	KER	A2	6459478	1794764.7	A2-56	4656+72	36" DBLRCP	Unknown	90.00	136	0	136	248.92	260.12	11.20
Z5	KER	A2	6459899	1793244	A2-57	4672+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	136	0	136	261.87	263.26	1.39
Z5	KER	A2	6460313	1791749.5	A2-58	4688+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	184	0	184	267.96	267.46	0.50
Z5	KER	A2	6460726	1790257.7	A2-59	4703+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	150	0	150	273.61	271.64	1.97
Z5	KER	A2	6461140	1788761.2	A2-60	4719+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	135	0	135	260.93	275.83	14.90
Z5	KER	A2	6461583	1787157.3	A2-61	4735+66	36" DBLRCP	Unknown	90.00	135	0	135	273.01	280.42	7.42
Z5	KER	A2	6461993	1785623.4	A2-62	4751+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	135	0	135	274.62	284.61	9.99
Z5	KER	A2	6462343	1784116.3	A2-63	4767+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	123	0	123	277.75	288.79	11.04
Z5	KER	A2	6462642	1782598.4	A2-64	4782+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	133	0	133	275.99	291.44	15.45
Z5	KER	A2	6462889	1781065.5	A2-65	4798+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	133	0	133	281.59	292.84	11.25
Z5	KER	A2	6463083	1779531.2	A2-66	4813+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	133	0	133	283.16	294.23	11.07
Z5	KER	A2	6463226	1777960.2	A2-67	4829+24	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	284.44	295.66	11.21
Z5	KER	A2	6463245	1777685.1	A2-68	4832+00.00	10'x4' RCBC	floodplain drainage	90.00	120	0	120	285.73	295.9	10.17
Z5	KER	A2	6463264	1777385.7	A2-69	4835+00.00	10'x4' RCBC	floodplain drainage	90.00	120	0	120	284.95	296.17	11.23
Z5	KER	A2	6463281	1777086.2	A2-70	4838+00.00	10'x4' RCBC	floodplain drainage	90.00	120	0	120	284.57	296.45	11.88
Z5	KER	A2	6463296	1776786.5	A2-71	4841+00.00	10'x4' RCBC	floodplain drainage	90.00	120	0	120	284.11	296.72	12.61
Z5	KER	A2	6463309	1776486.8	A2-72	4844+00.00	10'x4' RCBC	floodplain drainage	90.00	120	0	120	284.76	296.99	12.22
Z5	KER	A2	6463313	1776386.5	A2-73	4845+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	120	284.84	297.08	12.23
Z5	KER	A2	6463320	1776187	A2-74	4847+00.01	10'x4' RCBC	floodplain drainage	90.00	120	0	120	285.84	297.26	11.42
Z5	KER	A2	6463329	1775887.1	A2-75	4850+00.03	10'x4' RCBC	floodplain drainage	90.00	120	0	120	286.5	297.53	11.02
Z5	KER	A2	6463336	1775587.2	A2-76	4853+00.00	10'x4' RCBC	floodplain drainage	90.00	120	0	120	288.05	297.8	9.75
Z5	KER	A2	6463342	1775287.3	A2-77	4856+00.00	10'x4' RCBC	floodplain drainage	90.00	171	0	171	287.15	298.07	10.92
Z5	KER	A2	6463344	1775087.3	A2-78	4858+00.00	10'x4' RCBC	floodplain drainage	90.00	179	0	179	285.93	298.25	12.32
Z5	KER	A2	6463345	1774887.3	A2-79	4860+00.00	10'x4' RCBC	floodplain drainage	90.00	179	0	179	287.31	298.43	11.11
Z5	KER	A2	6463345	1774687.5	A2-80	4861+99.84	10'x4' RCBC	floodplain drainage	90.00	179	0	179	287.38	298.61	11.22
Z5	KER	A2	6463345	1774575.2	A2-81	4863+12	36" RCP	Unknown	90.00	179	0	179	287.53	298.71	11.18
Z5	KER	A2	6463345	1774487.4	A2-82	4863+99.92	10'x4' RCBC	floodplain drainage	90.00	179	0	179	287.74	298.79	11.05
Z5	KER	A2	6463344	1774287.3	A2-83	4866+00.01	10'x4' RCBC	floodplain drainage	90.00	179	0	179	286.29	298.97	12.68
Z5	KER	A2	6463343	1774087.3	A2-84	4868+00.00	10'x4' RCBC	floodplain drainage	90.00	179	0	179	287.92	299.15	11.23
Z5	KER	A2	6463341	1773887.4	A2-85	4869+99.88	10'x4' RCBC	floodplain drainage	90.00	179	0	179	287.64	299.33	11.69
Z5	KER	A2	6463339	1773687.4	A2-86	4871+99.93	10'x4' RCBC	floodplain drainage	90.00	179	0	179	286.96	299.51	12.54
Z5	KER	A2	6463336	1773487.5	A2-87	4873+99.88	10'x4' RCBC	floodplain drainage	90.00	179	0	179	286.67	299.69	13.02
Z5	KER	A2	6463334	1773287.5	A2-88	4875+99.88	10'x4' RCBC	floodplain drainage	90.00	179	0	179	287.39	299.87	12.47
Z5	KER	A2	6463332	1773087.6	A2-89	4877+99.82	10'x4' RCBC	floodplain drainage	90.00	179	0	179	287.85	300.05	12.20
Z5	KER	A2	6463331	1773002.5	A2-90	4878+85	10'x3' RCBC	Wildlife Crossing Structure	90.00	179	0	179	287.95	300.13	12.18
Z5	KER	A2	6463329	1772887.5	A2-91	4879+99.88	10'x4' RCBC	floodplain drainage	90.00	179	0	179	288.9	300.23	11.33
Z5	KER	A2	6463327	1772687.5	A2-92	4881+99.88	10'x4' RCBC	floodplain drainage	90.00	237	0	237	287.96	300.41	12.45
Z5	KER	A2	6463325	1772487.5	A2-93	4883+99.88	10'x4' RCBC	floodplain drainage	90.00	179	0	179	290.05	300.59	10.54
Z5	KER	A2	6463322	1772287.5	A2-94	4885+99.96	10'x4' RCBC	floodplain drainage	90.00	179	0	179	289.66	300.77	11.11
Z5	KER	A2	6463320	1772087.6	A2-95	4887+99.88	10'x4' RCBC	floodplain drainage	90.00	179	0	179	288.52	300.95	12.43
Z5	KER	A2	6463318	1771880.6	A2-96	4890+06.89	10'x4' RCBC	floodplain drainage	90.00	237	0	237	289.74	301.14	11.39
Z5	KER	A2	6463315	1771679	A2-97	4892+08.43	10'x4' DBL RCBC	floodplain drainage	90.00	134	0	134	290.74	301.32	10.58
Z5	KER	A2	6463313	1771478.2	A2-98	4894+09.27	10'x4' DBL RCBC	floodplain drainage	90.00	134	0	134	289.63	301.5	11.87
Z5	KER	A2	6463312	1771437.3	A2-99	4894+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	134	0	134	289.45	301.54	12.08
Z5	KER	A2	6463311	1771276.7	A2-100	4896+10.83	10'x4' DBL RCBC	floodplain drainage	90.00	134	0	134	289.11	301.68	12.57

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ZONE	COUNTY	HST ALIGN	Easting	Northing	Point ID	Sta #	Proposed Facility (internal width x internal height)	Purpose/ Existing Feature Crossed	Crossing angle (clockwise from North)	ROW width (ft)	additional dist. either side (ft)	Total length of channel spanned by culvert (ft)	Existing Elevation (of INV)	Proposed Elevation (of track)	Distance to Top of Rail (ft)
Z5	KER	A2	6463309	1771078.7	A2-101	4898+08.78	10'x4' DBL RCBC	floodplain drainage	90.00	134	0	134	290.99	301.86	10.87
Z5	KER	A2	6463306	1770880.8	A2-102	4899+54.37	10'x4' DBL RCBC	floodplain drainage	90.00	134	0	134	291.09	302.04	10.95
Z5	KER	A2	6463304	1770678.8	A2-103	4900+06.77	10'x4' DBL RCBC	floodplain drainage	90.00	134	0	134	291.48	302.22	10.74
Z5	KER	A2	6463302	1770471.7	A2-104	4902+08.74	10'x4' DBL RCBC	floodplain drainage	90.00	134	0	134	291.34	302.41	11.06
Z5	KER	A2	6463299	1770287.7	A2-105	4904+15.86	10'x4' RCBC	floodplain drainage	90.00	134	0	134	289.61	302.57	12.96
Z5	KER	A2	6463297	1770087.4	A2-106	4905+99.90	10'x4' RCBC	floodplain drainage	90.00	134	0	134	289.35	302.75	13.40
Z5	KER	A2	6463295	1769987.8	A2-107	4909+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	134	0	134	289.8	302.93	13.14
Z5	KER	A2	6463292	1769887.7	A2-108	4910+00.58	10'x4' RCBC	floodplain drainage	90.00	134	0	134	289.8	302.93	13.14
Z5	KER	A2	6463292	1769687.7	A2-109	4911+99.94	10'x4' RCBC	floodplain drainage	90.00	134	0	134	291.25	303.11	11.86
Z5	KER	A2	6463290	1769487.6	A2-110	4913+99.97	10'x4' RCBC	floodplain drainage	90.00	134	0	134	291.19	303.29	12.11
Z5	KER	A2	6463288	1769287.6	A2-111	4916+00.01	10'x4' RCBC	floodplain drainage	90.00	134	0	134	291.31	303.47	12.17
Z5	KER	A2	6463286	1769087.7	A2-112	4917+99.99	10'x4' RCBC	floodplain drainage	90.00	134	0	134	293.06	303.65	10.59
Z5	KER	A2	6463283	1768887.8	A2-113	4919+99.88	10'x4' RCBC	floodplain drainage	90.00	134	0	134	291.8	303.83	12.04
Z5	KER	A2	6463281	1768686.6	A2-114	4922+01.12	10'x4' RCBC	floodplain drainage	90.00	134	0	134	293.31	304.01	10.71
Z5	KER	L1	6163889	2437871.2	L1-01	5154+40	10'x4' DBL RCBC	Floodplain drainage	90.00	120	0	120	284.06	295.15	11.09
Z5	KER	L1	6163991	2437547.4	L1-02	5158+00	10'x3' RCRC	Wildlife Crossing Structure	90.00	120	0	73	284.74	295.78	11.04
Z5	KER	L1	6164038	2437394.7	L1-03	5159+50	10'x4' DBL RCBC	Floodplain drainage	90.00	120	0	120	285.29	296.07	10.78
Z5	KER	L1	6164180	2436916.4	L1-04	5164+58	10'x4' DBL RCBC	Floodplain drainage	90.00	120	0	120	286.56	296.97	10.41
Z5	KER	L1	6164318	2436435.6	L1-05	5169+58	10'x4' DBL RCBC	Floodplain drainage	90.00	120	0	120	287.31	297.87	10.56
Z5	KER	L1	6164422	2436059.5	L1-06	5173+50	10'x3' RCRC	Wildlife Crossing Structure	90.00	120	0	73	288.58	298.57	9.99
Z5	KER	L1	6164455	2435932.9	L1-07	5174+79	10'x4' RCBC	Floodplain drainage	90.00	120	0	120	288.34	298.81	10.47
Z5	KER	L1	6164575	2435476.2	L1-08	5179+52	10'x4' RCBC	Floodplain drainage	90.00	120	0	120	289.58	299.68	10.10
Z5	KER	L1	6164697	2434991.2	L1-09	5184+52	10'x4' RCBC	Floodplain drainage	90.00	120	0	120	291.14	301.28	10.14
Z5	KER	L1	6164841	2434380.4	L1-10	5190+79	13'x10' DBL RCBC	Unnamed Canal	104.00	120	25	170	288.89	304.76	15.87
Z5	KER	L1	6164860	2434297.4	L1-11	5191+65	10'x4' RCBC	Floodplain drainage	90.00	120	0	120	291.53	305.35	13.82
Z5	KER	L1	6164998	2433677.3	L1-12	5198+00	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	292.56	310.51	17.95
Z5	KER	L1	6165135	2433003	L1-13	5204+89	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	73	294.83	316.3	21.47
Z5	KER	L1	6165250	2432402.6	L1-14	5211+00	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	294.54	321.03	26.49
Z5	KER	L1	6165370	2431712.8	L1-15	5218+00	48"RCP	Unknown (equivalent to adjacent BNSF)	90.00	250	0	250	295.55	324.59	29.03
Z5	KER	L1	6165465	2431120	L1-16	5224+00	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	73	296.93	325.78	28.85
Z5	KER	L1	6165502	2430872.9	L1-17	5226+50	240' Bridge	Poso Creek	141.00	120	0	120	294.13	326.11	31.98
Z5	KER	L1	6165560	2430475.3	L1-18	5230+50	10'x3' RCBC	Wildlife Crossing Structure	90.00	120	0	73	298.45	325.76	27.32
Z5	KER	L1	6165655	2429732.3	L1-19	5238+00	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	299.93	323.33	23.40
Z5	KER	L1	6165745	2428938.2	L1-20	5246+00	10'x3' RCRC	Wildlife Crossing Structure	90.00	120	0	73	300.46	319.9	19.45
Z5	KER	L1	6165829	2428041.3	L1-21	5255+00	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	301.64	316.88	15.25
Z5	KER	L1	6165878	2427394.8	L1-22	5261+50	10'x3' RCRC	Wildlife Crossing Structure	90.00	120	0	73	302.36	316.72	14.35
Z5	KER	L1	6165958	2425845.9	L1-23	5277+00	10'x3' RCRC	Wildlife Crossing Structure	90.00	120	0	73	302.66	317.17	14.51
Z5	KER	L1	6165984	2424546.4	L1-24	5290+00	10'x3' RCRC	Wildlife Crossing Structure	90.00	120	0	73	307.71	320	12.30
Z5	KER	L1	6165974	2423313.2	L1-25	5302+22	60" DBL RCP	Unknown (equivalent to adjacent BNSF)	90.00	128	0	128	308.94	321.42	12.48
Z5	KER	L1	6165952	2422239.7	L1-26	5313+07	7'x5' RCBC	Unknown	90.00	128	0	128	310.02	322.66	12.65
Z5	KER	L2	6163890	2437871.3	L2-01	5154+40	10'x4' DBL RCBC	Floodplain drainage	90.00	120	0	120	284.07	295.17	11.10
Z5	KER	L2	6163991	2437547.4	L2-02	5158+00	10'x3' RCRC	Wildlife Crossing Structure	90.00	120	0	73	284.74	295.78	11.04
Z5	KER	L2	6164038	2437394.7	L2-03	5159+50	10'x4' DBL RCBC	Floodplain drainage	90.00	120	0	120	285.29	296.07	10.78
Z5	KER	L2	6164180	2436916.4	L2-04	5164+58	10'x4' DBL RCBC	Floodplain drainage	90.00	120	0	120	286.57	296.97	10.40
Z5	KER	L2	6164318	2436435.6	L2-05	5169+58	10'x4' DBL RCBC	Floodplain drainage	90.00	120	0	120	287.31	297.87	10.56
Z5	KER	L2	6164422	2436059.5	L2-06	5173+50	10'x3' RCRC	Wildlife Crossing Structure	90.00	120	0	73	288.58	298.57	9.99
Z5	KER	L2	6164455	2435932.9	L2-07	5174+79	10'x4' RCBC	Floodplain drainage	90.00	120	0	120	288.34	298.8	10.47

HYDRAULIC CROSSING POINTS

ZONE	COUNTY	HST ALIGN	Easting	Northing	Point ID	Sta #	Proposed Facility (internal width x internal height)	Purpose/ Existing Feature Crossed	Crossing angle (clockwise from North)	ROW width (ft)	additional dist. either side (ft)	Total length of channel spanned by culvert (ft)	Existing Elevation (of INV)	Proposed Elevation (of track)	Distance to Top of Rail (ft)
Z5	KER	L2	6164575	2435476.2	L2-08	5179+52	10'x4' RCBC	Floodplain drainage	90.00	120	0	120	289.57	299.81	10.23
Z5	KER	L2	6164697	2434991.2	L2-09	5184+52	10'x4' RCBC	Floodplain drainage	90.00	120	0	120	291.14	301.83	10.69
Z5	KER	L2	6164841	2434380.4	L2-10	5190+79	13'x10' DBL RCBC	Unnamed Canal	104.00	120	25	170	288.89	305.9	17.02
Z5	KER	L2	6164860	2434297.9	L2-11	5191+65	10'x4' RCBC	Floodplain drainage	90.00	120	0	120	291.53	306.54	15.01
Z5	KER	L2	6164998	2433677.3	L2-12	5198+00	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	292.56	311.31	18.75
Z5	KER	L2	6165135	2433003	L2-13	5204+89	10'x3' RCRC	Wildlife Crossing Structure	90.00	120	0	73	294.84	316.34	21.50
Z5	KER	L2	6165250	2432402.6	L2-14	5211+00	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	294.54	319.86	25.31
Z5	KER	L2	6165370	2431712.8	L2-15	5218+00	48"RCP	Unknown (equivalent to adjacent BNSF)	90.00	250	0	250	295.55	322.81	27.25
Z5	KER	L2	6165465	2431120	L2-16	5222+50	10'x3' RCRC	Wildlife Crossing Structure	90.00	120	0	73	297.04	325.23	28.19
Z5	KER	L2	6165502	2430872.9	L2-17	5226+50	110' span on viaduct	Poso Creek	141.00	120	0	120	294.13	326.23	32.10
Z5	KER	L2	6166498	2423358	L2-18	5302+30.57	8'x5' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	100	0	100	310.66	335.12	24.46
Z5	KER	L2	6166647	2422227.2	L2-19	5313+71	4'x3' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	100	0	100	311.76	329.53	17.77
Z5	KER	L2	6166806	2421017.8	L2-20	5325+90	10'x9' RCBC	Unnamed Canal, 9-22	98.00	120	25	170	312.54	326.24	13.70
Z5	KER	L2	6167009	2419475.2	L2-21	5341+50	5'x3' RCRC	Periodic hydraulic relief	90.00	120	0	73	315.78	327.92	12.14
Z5	KER	L2	6167214	2417935.6	L2-22	5357+00	5'x3' RCRC	Periodic hydraulic relief	90.00	120	0	73	318.43	329.77	11.34
Z5	KER	L2	6167456	2416403.2	L2-23	5372+50	5'x3' RCRC	Periodic hydraulic relief	90.00	120	0	73	320.43	331.62	11.19
Z5	KER	L3	6166290	2438111.4	L3-01	5154+15	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	293.12	304.22	11.10
Z5	KER	L3	6166290	2438060.7	L3-02	5155+00	10'x3' RCRC	Wildlife Crossing Structure	90.00	136	0	73	293.09	304.27	11.17
Z5	KER	L3	6166283	2437809.6	L3-03	5157+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	292.95	304.49	11.55
Z5	KER	L3	6166277	2437509.9	L3-04	5160+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	292.98	304.76	11.78
Z5	KER	L3	6166271	2437211.3	L3-05	5163+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	293.02	305.03	12.01
Z5	KER	L3	6166264	2436908.5	L3-06	5166+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	293.1	305.31	12.21
Z5	KER	L3	6166258	2436607.9	L3-07	5169+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	293.24	305.58	12.34
Z5	KER	L3	6166254	2436411.8	L3-08	5170+50	10'x3' RCRC	Wildlife Crossing Structure	90.00	136	0	73	293.25	305.67	12.42
Z5	KER	L3	6166249	2436213.8	L3-09	5171+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	293.25	305.76	12.51
Z5	KER	L3	6166245	2436060.7	L3-10	5173+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	293.25	305.94	12.69
Z5	KER	L3	6166245	2436010	L3-11	5175+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	293.25	306.12	12.87
Z5	KER	L3	6166241	2435803.5	L3-12	5177+50	10'x4' DBL RCBC	Floodplain drainage	90.00	136	0	136	293.25	306.31	13.06
Z5	KER	L3	6166236	2435603	L3-13	5179+50	10'x4' DBL RCBC	Floodplain drainage	90.00	136	0	136	288.01	306.49	18.48
Z5	KER	L3	6166232	2435404.4	L3-14	5181+50	10'x4' DBL RCBC	Floodplain drainage	90.00	136	0	136	287.68	306.67	18.99
Z5	KER	L3	6166228	2435203.1	L3-15	5183+57	10'x4' DBL RCBC	Floodplain drainage	90.00	136	0	136	287.68	306.85	19.17
Z5	KER	L3	6166224	2435004.5	L3-16	5185+56	10'x4' DBL RCBC	Floodplain drainage	90.00	136	0	136	287.69	307.03	19.34
Z5	KER	L3	6166219	2434804.7	L3-17	5187+55	10'x4' DBL RCBC	Floodplain drainage	90.00	136	0	136	287.69	307.21	19.52
Z5	KER	L3	6166215	2434612.2	L3-18	5189+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	287.68	307.39	19.71
Z5	KER	L3	6166211	2434413.8	L3-19	5191+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	287.68	307.56	19.89
Z5	KER	L3	6166210	2434347.1	L3-20	5192+20	15'x10' DBL RCBC	Unnamed Canal	90.00	136	25	186	295.21	307.63	12.42
Z5	KER	L3	6166207	2434210	L3-21	5193+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	295.57	307.82	12.25
Z5	KER	L3	6166203	2434011.5	L3-22	5195+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	295.61	308.25	12.64
Z5	KER	L3	6166198	2433810.5	L3-23	5197+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	296.18	308.85	12.67
Z5	KER	L3	6166177	2432814	L3-24	5207+50	10'x3' RCRC	Wildlife Crossing Structure	90.00	136	0	73	296.91	314.43	17.51
Z5	KER	L3	6166159	2431961.2	L3-25	5216+00	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	297.86	320.76	22.91
Z5	KER	L3	6166152	2431648.4	L3-26	5219+12	4'x4'RCBC	Unknown (equivalent to adjacent BNSF)	90.00	268	0	268	304.46	323.08	18.62
Z5	KER	L3	6166140	2431061.2	L3-27	5225+00	5'x3' RCBC	Periodic hydraulic relief	90.00	118	0	118	298.89	326.57	27.67
Z5	KER	L3	6166125	2430381.7	L3-28	5231+79	10'x3' RCRC	Wildlife Crossing Structure	90.00	118	0	73	300.79	328.72	27.93
Z5	KER	L3	6166119	2430076.5	L3-29	5234+85	280' Bridge	Poso Creek	168.00	80	0	80	295.87	329.03	33.16
Z5	KER	L3	6166109	2429613	L3-30	5239+50	10'x3' RCRC	Wildlife Crossing Structure	90.00	118	0	73	300.29	328.71	28.42
Z5	KER	L3	6166094	2428865.2	L3-31	5247+00	5'x3' RCBC	Periodic hydraulic relief	90.00	118	0	118	301.2	326.22	25.02
Z5	KER	L3	6166076	2428062.3	L3-32	5255+00	10'x3' RCRC	Wildlife Crossing Structure	90.00	118	0	73	301.74	322.34	20.60

ZONE	COUNTY	HST ALIGN	Easting	Northing	Point ID	Sta #	Proposed Facility (internal width x internal height)	Purpose/ Existing Feature Crossed	Crossing angle (clockwise from North)	ROW width (ft)	additional dist. either side (ft)	Total length of channel spanned by culvert (ft)	Existing Elevation (of INV)	Proposed Elevation (of track)	Distance to Top of Rail (ft)
Z5	KER	L3	6166044	2426562.6	L3-33	5270+00	10'x3' RCRC	Wildlife Crossing Structure	90.00	136	0	73	304.18	317.83	13.65
Z5	KER	L3	6166010	2424965.7	L3-34	5285+97	10'x3' RCRC	Wildlife Crossing Structure	90.00	136	0	73	307.16	319.52	12.36
Z5	KER	L3	6165976	2423367.1	L3-35	5301+95	60" DBL RCP	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	308.85	321.36	12.51
Z5	KER	L3	6165952	2422239.7	L3-36	5313+23	7'x5' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	310.02	322.66	12.65
Z5	KER	L4	6166290	2438111.4	L4-01	5154+15	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	293.12	304.22	11.10
Z5	KER	L4	6166290	2438060.6	L4-02	5155+00	10'x3' RCRC	Wildlife Crossing Structure	90.00	136	0	73	293.09	304.27	11.17
Z5	KER	L4	6166283	2437809.6	L4-03	5157+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	292.95	304.49	11.54
Z5	KER	L4	6166277	2437509.9	L4-04	5160+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	292.98	304.76	11.78
Z5	KER	L4	6166271	2437211.3	L4-05	5163+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	293.02	305.03	12.01
Z5	KER	L4	6166264	2436908.5	L4-06	5166+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	293.1	305.3	12.20
Z5	KER	L4	6166258	2436607.9	L4-07	5169+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	293.24	305.57	12.34
Z5	KER	L4	6166255	2436509.9	L4-08	5170+50	10'x3' RCRC	Wildlife Crossing Structure	90.00	136	0	73	293.25	305.66	12.41
Z5	KER	L4	6166254	2436411.8	L4-09	5171+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	293.25	305.75	12.50
Z5	KER	L4	6166249	2436213.8	L4-10	5173+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	293.25	305.93	12.68
Z5	KER	L4	6166245	2436010	L4-11	5175+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	293.25	306.11	12.86
Z5	KER	L4	6166241	2435803.5	L4-12	5177+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	293.25	306.3	13.05
Z5	KER	L4	6166236	2435603	L4-13	5179+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	288.01	306.48	18.47
Z5	KER	L4	6166232	2435404.4	L4-14	5181+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	287.68	306.66	18.97
Z5	KER	L4	6166228	2435203.1	L4-15	5183+57	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	287.68	306.84	19.15
Z5	KER	L4	6166224	2435004.5	L4-16	5185+56	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	287.69	307.02	19.33
Z5	KER	L4	6166219	2434804.7	L4-17	5187+55	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	287.69	307.2	19.50
Z5	KER	L4	6166215	2434612.2	L4-18	5189+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	287.68	307.37	19.69
Z5	KER	L4	6166211	2434413.8	L4-19	5191+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	287.68	307.55	19.87
Z5	KER	L4	6166210	2434347.1	L4-20	5192+14	15'x10' DBL RCBC	Unnamed Canal	90.00	136	25	186	295.21	307.61	12.40
Z5	KER	L4	6166207	2434210	L4-21	5193+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	295.57	307.73	12.16
Z5	KER	L4	6166203	2434011.5	L4-22	5195+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	295.61	307.91	12.30
Z5	KER	L4	6166198	2433810.5	L4-23	5197+50	10'x4' RCBC	Floodplain drainage	90.00	136	0	136	296.18	308.09	11.91
Z5	KER	L4	6166180	2432960.8	L4-24	5206+00	10'x3' RCRC	Wildlife Crossing Structure	90.00	136	0	73	296.77	309.78	13.01
Z5	KER	L4	6166159	2431961.2	L4-25	5216+00	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	297.85	315.7	17.84
Z5	KER	L4	6166152	2431648.2	L4-26	5219+12	48" RCP	Unknown (equivalent to adjacent BNSF)	90.00	268	0	268	304.46	318.17	13.71
Z5	KER	L4	6166140	2431061.2	L4-27	5225+00	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	298.89	322.8	23.91
Z5	KER	L4	6166126	2430407.5	L4-28	5231+54	10'x3' RCRC	Wildlife Crossing Structure	90.00	136	0	73	300.74	327.68	26.94
Z5	KER	L4	6166119	2430076.5	L4-29	5234+85	240' bridge	Poso Creek	168.00	80	0	80	295.87	329.64	33.77
Z5	KER	L4	6166109	2429613	L4-30	5239+50	10'x3' RCRC	Wildlife Crossing Structure	90.00	120	0	120	300.29	331.74	31.46
Z5	KER	L4	6166088	2428633.6	L4-31	5249+28	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	301.59	335.4	33.81
Z5	KER	L4	6166074	2427963.4	L4-32	5256+00	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	301.74	337.53	35.79
Z5	KER	L4	6166289	2420709.8	L4-33	5328+62	10'x8' DBL RCBC	Unnamed Canal, 9-22	90.00	100	25	150	312.73	335.75	23.02
Z5	KER	L4	6166438	2419480.8	L4-34	5341+00	10'x3' RCRC	Wildlife Crossing Structure	90.00	126	0	73	314.25	328.2	13.95
Z5	KER	L4	6166672	2417951.9	L4-35	5356+50	10'x3' RCRC	Wildlife Crossing Structure	90.00	120	0	73	317.43	327.83	10.40
Z5	KER	L4	6166959	2416425.4	L4-36	5372+00	10'x3' RCRC	Wildlife Crossing Structure	90.00	120	0	73	319.46	330.25	10.79
Z5	KER	WS1	6165728	2420980.4	WS1-01	approx 5428+85	15'x11' DBL RCBC	Culvert under systems road, 9-22	N/A	48	0	48	N/A	N/A	N/A
Z5	KER	WS1	6165918	2420678.8	WS1-02	5428+85	15'x11' DBL RCBC	Unnamed canal, 9-22	90.00	136	25	186	315.69	324.46	8.77
Z5	KER	WS1	6165799	2415065.2	WS1-03	5485+00	14'x6' RCBC	Culvert under Existing BNSF	90.00	136	0	136	319.78	330.91	11.14
Z5	KER	WS1	6165774	2413897.8	WS1-04	5496+67	8'x4' RCBC	Culvert under Existing BNSF	90.00	136	0	136	318.24	332.26	14.01
Z5	KER	WS1	6166407	2392080	WS1-05	5715+73	8'x4' RCBC	Culvert under adjacent road	N/A	136	0	136	N/A	N/A	N/A
Z5	KER	WS1	6167521	2389171.5	WS1-06	5747+00	5'x3' RCBC	Periodic hydraulic relief	90.00	136	0	136	338.46	349.79	11.33
Z5	KER	WS1	6168704	2386970.3	WS1-07	5774+00	5'x3' RCBC	Periodic hydraulic relief	90.00	136	0	136	341.97	353.04	11.06

ZONE	COUNTY	HST ALIGN	Easting	Northing	Point ID	Sta #	Proposed Facility (internal width x internal height)	Purpose/ Existing Feature Crossed	Crossing angle (clockwise from North)	ROW width (ft)	additional dist. either side (ft)	Total length of channel spanned by culvert (ft)	Existing Elevation (of INV)	Proposed Elevation (of track)	Distance to Top of Rail (ft)
Z5	KER	WS1	6183197	2371408.8	WS1-08	5985+00	5'x3' RCBC	Periodic hydraulic relief	90.00	136	0	136	347.96	355.57	7.61
Z5	KER	WS1	6185076	2369470.7	WS1-09	6012+00	5'x3' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	193	0	193	346.43	355.57	9.14
Z5	KER	WS1	6193552	2360137.3	WS1-10	6138+18	4'x3' RCBC	Culvert under Existing BNSF	90.00	100	0	100	341.54	364.38	22.83
Z5	KER	WS1	6195641	2358090.1	WS1-11	6167+44	5'x4' RCBC	Culvert under Existing BNSF	90.00	120	0	120	337.44	346.62	9.18
Z5	KER	WS1	6196187	2357557	WS1-12	6175+00	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	337.23	346.36	9.13
Z5	KER	WS1	6196899	2356856.6	WS1-13	6185+00	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	336.61	346.06	9.45
Z5	KER	WS1	6197429	2356335.6	WS1-14	6192+41	5'x4' RCBC	Culvert under Existing BNSF	90.00	120	0	120	336.21	345.83	9.62
Z5	KER	WS1	6197966	2355800.1	WS1-15	6200+00	5'x3' RCBC	Periodic hydraulic relief	90.00	141	0	141	335.93	345.61	9.68
Z5	KER	WS1	6200445	2353264.7	WS1-16	6235+45	5'x4' RCBC	Culvert under Existing BNSF	90.00	136	0	136	337	344.93	7.93
Z5	KER	WS1	6205840	2347730.7	WS1-17	6312+75	36" RCP	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	342.82	350.12	7.31
Z5	KER	WS1	6208688	2344809.3	WS1-18	6353+69	36" RCP	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	347.69	352.87	5.18
Z5	KER	WS1	6209702	2343769.4	WS1-19	6368+06	36" DBL RCP	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	349.27	353.85	4.58
Z5	KER	WS1	6212641	2340755.1	WS1-20	6410+18	10'x6' DBL RCBC	Unnamed Canal, R-0	N/A	136	25	186	N/A	N/A	N/A
Z5	KER	WS1	6212584	2341098.8	WS1-21	approx 6405+00	10'x6' DBL RCBC	Culvert under Kratzmeyer Road, R-3	N/A	466	25	516	N/A	N/A	N/A
Z5	KER	WS1	6213896	2341106.5	WS1-22	approx 6405+01	10'x6' DBL RCBC	Culvert under Kratzmeyer Road, R-0	N/A	120	0	120	N/A	N/A	N/A
Z5	KER	WS1	6212418	2340616.1	WS1-23	approx 6410+00	11'x8' DBL RCBC	Culvert under road, Rudd Ave, R-4	N/A	86	25	136	349.99	355.62	N/A
Z5	KER	WS1	6213606	2339765.2	WS1-24	6424+14	5'x4' RCBC	Culvert under Existing BNSF	90.00	136	0	136	348.61	356.54	7.93
Z5	KER	WS1	6217177	2336102.7	WS1-25	6475+15	8'x4' RCBC	Culvert under Existing BNSF	90.00	136	0	136	359.57	367.77	8.21
Z5	KER	WS1	6218702	2334538.1	WS1-26	6497+00	4'x3' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	360.26	368.38	8.12
Z5	KER	WS2	6193371	2365155.8	WS2-01	6054+03	4'x3' RCBC	Unknown (existing hydraulic feature not adjacent to BNSF)	90.00	120	0	120	353.99	362.67	8.68
Z5	KER	WS2	6195905	2360655.1	WS2-02	6105+68	5'x3' RCBC	Periodic hydraulic relief	90.00	120	0	120	346.67	357.37	10.70
Z5	KER	WS2	6197077	2358698.8	WS2-03	6128+50	4'x3' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	180	0	180	343.83	355.02	11.18
Z5	KER	WS2	6198390	2356684.7	WS2-04	6152+55	4'x3' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	100	0	100	336.41	352.54	16.13
Z5	KER	WS2	6198815	2356069.8	WS2-05	6160+00	5'x3' RCBC	Periodic hydraulic relief	90.00	100	0	100	336.43	352	15.57
Z5	KER	WS2	6199394	2355255.2	WS2-06	6170+00	5'x3' RCBC	Periodic hydraulic relief	90.00	100	0	100	338.59	354.52	15.93
Z5	KER	WS2	6199927	2354529.2	WS2-07	6179+00	5'x3' RCBC	Periodic hydraulic relief	90.00	100	0	100	337.3	360.46	23.16
Z5	KER	WS2	6200350	2353972	WS2-08	6186+00	5'x3' RCBC	Periodic hydraulic relief	90.00	100	0	100	337.51	367.45	29.94
Z5	KER	WS2	6208688	2344809.3	WS2-09	6310+24	36" DBL RCP	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	347.69	356.5	8.81
Z5	KER	WS2	6209702	2343769.4	WS2-10	6324+50	5'x3' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	349.28	353.78	4.50
Z5	KER	WS2	6212641	2340755.1	WS2-11	6366+60	10'x6' DBL RCBC	Unnamed Canal, R-0	90.00	136	25	186	349.99	354.62	4.62
Z5	KER	WS2	6212584	2341098.8	WS2-12	approx 6361+00	10'x6' DBL RCBC	Culvert under Kratzmeyer Road, R-3	N/A	466	25	516	N/A	N/A	N/A
Z5	KER	WS2	6213896	2341106.5	WS2-13	approx 6361+01	10'x6' DBL RCBC	Culvert under Kratzmeyer Road, R-0	N/A	120	0	120	N/A	N/A	N/A
Z5	KER	WS2	6212428	2340653.9	WS2-14	approx 6366+02	11'x8' DBL RCBC	Culvert under Rudd Ave, R-4	N/A	86	0	86	N/A	N/A	N/A
Z5	KER	WS2	6213606	2339765.2	WS2-15	6380+43	5'x4' RCBC	Culvert under Existing BNSF	90.00	136	0	136	348.6	357.5	8.90
Z5	KER	WS2	6217177	2336102.7	WS2-16	6431+58	8'x4' RCBC	Culvert under Existing BNSF	90.00	136	0	136	359.57	367.76	8.20
Z5	KER	WS2	6218702	2334538.1	WS2-17	6453+43	4'x3' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	360.26	368.37	8.11
Z5	KER	B1	6220088	2333116	B1-01	6805+00	8'x4' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	365.33	368.75	3.42
Z5	KER	B1	6220773	2332415.4	B1-02	6814+77.51	5'x3' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	361.57	369.37	7.80
Z5	KER	B1	6225166	2328069.9	B1-03	6876+50	5'x4' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	373.89	377.26	3.37
Z5	KER	B1	6228677	2325085.7	B1-04	6922+75	5'x3' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	377.31	389.44	12.13
Z5	KER	B1	6237049	2321860	B1-05	7013+26	20' span on viaduct	Arvin Edison Canal	130.00	100	0	100	382.31	472.59	90.28
Z5	KER	B1	6237452	2321810.1	B1-06	7017+33	50' span on viaduct	Friant-Kern Canal Spillway	54.00	100	0	100	390.13	472.82	82.70
Z5	KER	B1	6237764	2321776.5	B1-07	7020+46	30' span, approx, on viaduct	New canal in pipeline	0.00	100	0	100	389.6	472.61	83.01
Z5	KER	B1	6241132	2321734.2	B1-08	7054+18	20' span on viaduct	Cross Valley Canal	157.00	100	0	100	388.75	474.97	86.22
Z5	KER	B1	6244662	2322307.9	B1-09	7090+00	720' span, on viaduct	Kern River	120.00	100	0	100	388.76	477.06	88.30
Z5	KER	B1	6247679	2322812.9	B1-10	7120+60	80' span, on viaduct	Gates Canal	115.00	100	0	100	388.91	478.34	89.43
Z5	KER	B1	6260556	2322991.8	B1-11	7249+50	60' span, on viaduct	Mill Creek/Kern Island Canal	90.00	100	0	100	401.48	450.53	49.05

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ZONE	COUNTY	HST ALIGN	Easting	Northing	Point ID	Sta #	Proposed Facility (internal width x internal height)	Purpose/ Existing Feature Crossed	Crossing angle (clockwise from North)	ROW width (ft)	additional dist. either side (ft)	Total length of channel spanned by culvert (ft)	Existing Elevation (of INV)	Proposed Elevation (of track)	Distance to Top of Rail (ft)
Z5	KER	B1	6274920	2322175.5	B1-12	7394+58	35' span, on viaduct	East Side Canal	34.00	100	0	100	421.7	489.52	67.81
Z5	KER	B1	6275713	2321830.6	B1-13	approx 7403+00	10'x8' DBL RCBC	Culvert under road, East Side Canal	N/A	370	0	370	N/A	N/A	N/A
Z5	KER	B2	6220088	2333116	B2-01	6805+00	8'x4' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	365.33	368.75	3.42
Z5	KER	B2	6220771	2332416.1	B2-02	6814+18	5'x3' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	361.58	369.37	7.79
Z5	KER	B2	6225165	2328070.4	B2-03	6876+01	5'x4' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	373.96	377.26	3.30
Z5	KER	B2	6228730	2325177.2	B2-04	6922+01	5'x3' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	378.26	391.91	13.65
Z5	KER	B2	6237462	2322182.6	B2-05	7015+19	55' span, on viaduct	Friant-Kern Canal	85.00	316	0	316	391.96	472.26	80.30
Z5	KER	B2	6237824	2322153.6	B2-06	7017+45	30' span, approx, on viaduct	New canal in pipeline	90.00	414	0	414	389.6	472.61	83.01
Z5	KER	B2	6244312	2322744.9	B2-07	7084+25	75' span, on viaduct	Cross Valley Canal	147.00	100	0	100	387.98	478.93	90.96
Z5	KER	B2	6245426	2322970.5	B2-08	7095+62	310' crossing, on viaduct	Kern River	149.00	100	0	100	384.52	480.03	95.51
Z5	KER	B2	6248239	2323266.5	B2-09	7123+93	75' crossing on viaduct	Gates Canal	143.00	100	0	100	391.02	478.39	87.37
Z5	KER	B2	6250305	2323277.8	B2-10	7144+54	23' span, on viaduct	Unnamed Canal	104.00	100	0	100	394.97	473.68	78.72
Z5	KER	B2	6260553	2322769.9	B2-11	7247+38	60' span, on viaduct	Mill Creek	83.00	100	0	100	398.85	450.46	51.61
Z5	KER	B2	6276911	2321467.5	B2-12	7411+65	25' span, on viaduct	Unnamed Canal	52.00	100	0	100	422.2	500.8	78.60
Z5	KER	B3	6220088	2333116	B3-01	6804+50	8'x4' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	365.33	368.75	3.42
Z5	KER	B3	6220771	2332416.1	B3-02	6814+18	5'x3' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	361.57	369.37	7.80
Z5	KER	B3	6225165	2328070.4	B3-03	6876+00	5'x4' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	374.01	377.26	3.24
Z5	KER	B3	6228730	2325177.2	B3-04	6922+00	5'x3' RCBC	Unknown (equivalent to adjacent BNSF)	90.00	136	0	136	378.25	391.92	13.67
Z5	KER	B3	6237462	2322182.7	B3-05	7015+19	55' span, on viaduct	Friant-Kern Canal	85.00	316	0	316	391.9	472.26	80.36
Z5	KER	B3	6237824	2322153.6	B3-06	7017+45	30' span, approx, on viaduct	New canal in pipeline	90.00	414	0	414	389.59	472.61	83.02
Z5	KER	B3	6244312	2322744.9	B3-07	7084+25	75' span, on viaduct	Cross Valley Canal	147.00	100	0	100	387.95	478.93	90.99
Z5	KER	B3	6245422	2322970	B3-08	7095+62	310' crossing, on viaduct	Kern River	149.00	100	0	100	384.52	480.03	95.51
Z5	KER	B3	6248232	2323262.9	B3-09	7123+93	75' crossing on viaduct	Gates Canal	143.00	100	0	100	391.14	478.66	87.52
Z5	KER	B3	6250307	2323277.7	B3-10	7144+54	23' span, on viaduct	Canal	104.00	100	0	100	395.02	474.37	79.35
Z5	KER	B3	6260553	2322854.2	B3-11	7247+38	60' span, on viaduct	Mill Creek	83.00	100	0	100	398.85	456.17	57.32
Z5	KER	B3	6274912	2322177.2	B3-12	7394+00	35' span, on viaduct	East Side Canal	34.00	100	0	100	421.7	497.01	75.30
Z5	KER	B3	6275713	2321830.6	B3-13	approx 7403+00	10'x8' DBL RCBC	Culvert under road, East Side Canal	N/A	370	0	370	N/A	N/A	N/A

Appendix C

Canal and Ditch Realignments

CANAL AND DITCH REALIGNMENTS

	Approximate Location		Dimensions		
Alignment	Station number from	Station number to	length (ft)	width (ft)	Identification
F1	0442+00	0452+00	967	10	Fresno Colony canal
M	0650+00	0655+00	602	16	Wilson No. 230
M	0667+00	0668+50	102	13	42" CIP to Oldeander North Branch No. 17
M	0735+50	0739+50	3104	20	Kirby Ditch
M	0952+00	0955+00	277	30	Harlan Stevens Ditch
M	1008+00	1013+00	3097	18	Elkhorn Ditch
H	1448+00	1452+00	824	48	Crosscut Waste
H	1816+00	1819+00	77	25	East Branch People's Ditch
H	1823+00	1834+00	1306	25	East Branch People's Ditch
H	2024+50	2030+00	185	11	Lakeside Ditch - Settler's Branch
H	2132+00	2140+00	792	13	Lakeside Ditch - Settler's Branch
HW	1584+00	1585+50	439	20	Hardwick Ditch
HW	1711+00	1720+00	1847	44	West Main Last Chance Ditch
HW	1802+00	1848+00	4668	35	East Main Last Chance Ditch
HW	1914+50	1916+50	206	44	Mussel Slough
HW	1988+00	1998+00	450	30	New Deal Ditch
HW2	1584+00	1585+50	439	20	Hardwick Ditch
HW2	1711+00	1720+00	1950	44	West Main Last Chance Ditch
HW2	1805+00	1842+00	3774	35	East Main Last Chance Ditch
HW2	1862+00	1874+00	1145	35	East Main Last Chance Ditch
HW2	1917+00	1920+00	243	44	Mussel Slough
K1	2031+00	2039+00	1003	30	People's Ditch/New Deal Ditch
K1	2102+00	2106+00	1000	15	Lakeside Ditch
K1	2122+00	2128+00	857	16	Lakeside Ditch
K1	2167+00	2177+00	1044	6	Unnamed Ditch
K1	2180+00	2186+00	800	6	Unnamed Ditch
K1	2235+50	2240+00	378	33	Melga Canal
K1	2290+50	2294+50	630	15	Lakeside Ditch
K1	2345+00	2374+50	3795	38	Wreden Ditch (Salvador Ditch)
K1	2375+00	2405+00	2994	28	Salvador Ditch
K1	2405+00	n/a	285	29	McCann no.1 Canal (Salvador Ditch)
K1	2495+00	2498+00	470	20	McCann no. 2 Ditch
K1	2502+00	2530+00	2836	14	realigned ditch at Kaweah Berm
K1	2543+00	2546+00	369	53	West Branch Lakeland Canal
K2	2031+00	2039+00	1212	29	People's Ditch/New Deal Ditch
K2	2103+00	2104+00	661	20	Lakeside Ditch
K2	2144+00	2154+00	1191	17	Lakeside Ditch
K2	2209+00	2211+00	438	8	Lakeside Ditch
K2	2259+00	2261+50	602	14	Unnamed Ditch
K2	2263+00	2269+00	888	40	Melga Canal
K2	2303+00	2306+00	621	16	Unnamed Ditch
K2	2306+00	2310+50	607	16	Lakeside Ditch - Guernsey Branch
K2	2348+00	2549+00	1181	17	Unnamed Ditch
K2	2367+00	2379+00	1494	27	Unnamed Ditch
K2	2379+50	2407+00	2926	33	Unnamed Ditch
K2	2407+50	2412+50	539	28	Unnamed Ditch
K2	2415+00	2437+00	2217	31	Unnamed Ditch
K2	2437+00	2459+00	2277	22	Unnamed Ditch
K2	2417+50	2460+00	4444	29	Unnamed Ditch
K2	2507+00	n/a	232	22	McCann no. 2 Ditch

CANAL AND DITCH REALIGNMENTS

	Approximate Location		Dimensions		
Alignment	Station number from	Station number to	length (ft)	width (ft)	Identification
K2	2532+00	2551+00	1938	20	Unnamed Ditch
K2	2595+00	2601+00	765	21	Unnamed Canal
K3	2119+50	2123+00	1676	20	Lakeside Ditch - Eucalyptus Branch
K3	2128+00	2131+50	1026	20	Lakeside Ditch - Eucalyptus Branch
K3	2140+00	2145+00	688	20	Lakeside Ditch - Eucalyptus Branch
K3	2170+00	2176+00	1727	30	Melga Canal
K3	2227+50	2254+00	2747	13	Unnamed Canal
K3	approx 2228+00	n/a	3295	n/a	Burr Pipeline
K3	2340+00	2346+00	513	11	Unnamed Canal
K3	2371+50	2374+50	n/a	n/a	Unnamed wetland
K3	2539+50	n/a	212	22	Unnamed Canal
K3	2564+00	2583+50	1920	21	Unnamed Canal
K3	2626+00	2634+00	765	21	Unnamed Canal
K4	2120+00	2146+50	4267	20	Lakeside Ditch - Eucalyptus Branch
K4	2170+00	2177+00	1727	30	Melga Canal
K4	2229+00	2255+00	2747	23	Unnamed Canal
K4	approx 2229+00	n/a	3295	n/a	Burr Pipeline
K4	2371+50	2374+50	n/a	n/a	Unnamed wetland
K4	2528+50	2531+00	310	22	McCann no. 2 Ditch
K4	2535+00	2564+00	2874	14	realigned ditch at Kaweah Berm
K4	2577+00	2580+00	390	53	West Branch Lakeland Canal
K5	2031+00	2039+00	1003	30	People's Ditch/New Deal Ditch
K5	2102+00	2120+00	3192	15	Lakeside Ditch
K5	2165+00	2175+00	990	8	Unnamed Ditch
K5	2180+00	2185+00	679	6	Unnamed Ditch
K5	2235+00	2241+00	813	35	Melga Canal
K5	2289+00	2294+00	688	15	Lakeside Ditch
K5	2342+00	2373+00	3704	38'	Wreden Ditch (Salvador Ditch)
K5	2374+50	2405+00	3002	28	Salvador Ditch
K5	2405+00	n/a	182	35	McCann No. 1 Canal (salvador Ditch)
K5	2494+50	2498+00	470	20	McCann no. 2 Ditch
K1	2502+00	2530+00	2836	14	realigned ditch at Kaweah Berm
K5	2543+00	2545+00	468	53	West Branch Lakeland Canal
K6	2031+00	2039+00	1212	29	People's Ditch/New Deal Ditch
K6	2103+00	n/a	460	18	Lakeside Ditch
K6	2134+50	2140+50	987	17	Lakeside Ditch
K6	2229+50	2233+00	513	17	Lakeside Ditch
K6	2255+00	2260+50	800	46	Melga canal
K6	2301+00	2305+00	618	16	Unnamed canal
K6	2306+00	2308+50	472	17	Lakeside Ditch
K6	2346+00	2349+00	834	18	Unnamed Ditch
K6	2364+50	2376+00	1494	27	Unnamed Ditch
K6	2377+00	2404+00	2926	33	Unnamed Ditch
K6	2405+00	2410+00	539	28	Unnamed Ditch
K6	2412+00	2434+00	2217	31	Unnamed Ditch
K6	2435+00	2456+50	2277	22	Unnamed Ditch
K6	2415+00	2456+50	4444	29	Unnamed Ditch
K6	2504+80	n/a	208	22	Unnamed Canal
K6	2592+00	n/a	900	23	Unnamed Canal
K6	2530+00	2549+00	1938	20	Unnamed Ditch
K6	2592+00	2599+00	765	21	Unnamed Canal

CANAL AND DITCH REALIGNMENTS

	Approximate Location		Dimensions		
Alignment	Station number from	Station number to	length (ft)	width (ft)	Identification
C1	2622+00	2626+50	462	67	Sweet Canal
C1	2629+50	n/a	122	38	Bean Ditch
C1	2750+00	n/a	112	16	North Corcoran Ditch
C1	2880+00	2918+00	4080	55	Sweet Canal
C1	2933+50	n/a	186	32	Unnamed Canal
C1	2971+00	2988+00	3447	44	Unnamed Canal
C1	2995+00	3029+00	6788	44	Unnamed Canal
C1	3042+00	3089+50	4750	23	Unnamed Canal
C1	3090+00	3095+50	582	25	Unnamed Canal
C2	2622+00	2626+50	319	67	Sweet Canal
C2	2629+50	n/a	122	38	Bean Ditch
C2	2688+50	2691+00	450	14	Unnamed Ditch
C2	2729+00	2750+00	2447	62	Sweet Canal
C2	2858+00	n/a	859	6	Unnamed Ditch
C2	2757+00	2758+50	349	6	Unnamed Ditch
C2	3009+00	3029+00	2065	40	Unnamed Canal
C2	3042+00	3090+00	4760	25	Unnamed Canal
C2	3090+00	3096+00	582	20	Unnamed Canal
C3	2634+50	2701+50	6743	23	Unnamed Canal
C3	2750+00	2757+00	1482	13	Unnamed Ditch
C3	2889+00	2918+50	3283	50	Sweet Canal
C3	2971+00	3029+00	5867	22	Unnamed Canal
C3	3042+00	3090+00	4760	40	Unnamed Canal
C3	3090+50	3096+00	582	25	Unnamed Canal
P	3096+00	3118+00	2055	25	Unnamed Canal
P	3173+00	3176+50	570	25	Taylor canal
P	3178+00	n/a	611	22	Unnamed Canal
P	3227+00	3235+00	1022	26	Unnamed Canal
P	3271+00	3335+00	6470	16	Unnamed ditch
P	3324+00	3337+00	1475	90	Lakeland Canal
P	3426+00	n/a	1106	10	Unnamed ditch
A1	3946+00	4003+00	5750	21	Unnamed canal
A1	4035+00	n/a	4969	40	Unnamed ditch
A1	4115+00	4117+00	2864	30	Unnamed ditch
A1	4240+00	4247+00	750	32	Unnamed ditch
A1	4240+00	4270+00	3363	40	Unnamed ditch
A1	4667+00	4674+00	1000	33	Unnamed canal
A2	3946+00	4003+00	5750	21	Unnamed canal
A2	4035+00	n/a	4969	40	Unnamed ditch
A2	4138+50	4156+00	1826	41	Unnamed ditch
A2	4223+00	4267+00	4720	40	Unnamed canal
L4	5325+00	5328+50	470	20	Unnamed canal
WS1	5425+50	5429+00	422	31	Unnamed canal
WS1	6329+00	n/a	142	21	pipeline extension
WS1	6404+00	6410+00	1909	28	Unnamed canal
WS1	6410+00	6417+00	810	31	Unnamed canal
WS1	6417+00	6420+00	362	20	Unnamed canal
WS2	6285+00	n/a	53	19	Unnamed canal

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CANAL AND DITCH REALIGNMENTS

	Approximate Location		Dimensions		
Alignment	**Station number from**	**Station number to**	**length (ft)**	**width (ft)**	**Identification**
WS2	6359+00	6366+00	1767	30	Unnamed canal
WS2	6366+00	6370+00	775	20	Unnamed canal
WS2	6373+00	6375+00	511	23	Unnamed canal
B1	6820+00	6821+00	151	12	Unnamed ditch
B1	7394+50	7398+00	408	25	Unnamed canal
B1	7400+00	741500	1535	25	Unnamed canal
B2	6820+00	6821+00	151	12	Unnamed ditch
B2	7019+00	n/a	1213	53	New Unnamed canal
B2	7060+00	7070+00	1021	70	New Unnamed canal
B2	7144+50	n/a	209	23	Unnamed canal
B2	7406+50	7416+00	549	25	New Unnamed canal
B3	6820+00	6821+00	151	12	Unnamed ditch
B3	7019+00	n/a	1213	53	New Unnamed canal
B3	7060+00	7070+00	1021	70	New Unnamed canal
B3	7144+50	n/a	209	23	Unnamed canal
B3	7394+00	7397+50	416	25	Unnamed canal
B3	7400+00	741500	1535	25	Unnamed canal